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AN EMPIRICAL METHOD OF CALCULATING FUTURE POPULATION*

By P. K. Whelpton
Scripps Foundation for Research in Population Problems

In view of the large number of estimates of the future population of the United States that had been made prior to 1926 and the variety of results that had been obtained, it may be wondered why the Scripps Foundation began to work in this field at that time. It should be emphasized that we had no feeling of possessing superior prophetic power. We did not expect to prepare more accurate estimates than some of those already available, but did believe we could present much valuable material in addition to the customary figures of total population. For example, a growing demand was being manifested for information regarding probable changes in the makeup of the population in years to come. Furthermore, it seemed worth while to obtain data showing the effect on population growth and composition of differences in future trends of birth rates, death rates, and immigration—differences that seemed reasonable in view of past trends and present conditions in the United States and other nations.

The method we developed was based on a consideration of births, deaths, immigration, and emigration by age periods.[1] It was necessary to consider native-born whites, foreign-born whites, Negroes, and other colored by sex in order to secure the detailed data desired regarding the future composition of the population. Using various trends of birth rates, death rates, and migration by nativity, age and sex showed the effect on future growth and composition of differences in these factors and permitted the reader to choose the results of the combination that

* Revision of a paper read before a joint meeting of the Population Association of America and the American Statistical Association, New York City, December 31, 1935.

[1] Although the method followed was worked out independently, much of it was found afterward to have been used by Bowley, A. L.: "Births and Population of Great Britain," *The Journal of the Royal Economic Society*, vol. 34 (1924), pp. 188–192.

seemed most reasonable to him rather than confining him to the current choice of the writers.[2] This paper will be confined to the procedure used in the calculations recently completed for the National Resources Committee, which differs in minor respects from that used previously.

ADJUSTING CENSUS DATA

The population according to the last census being taken as the starting point, the first step was to adjust for the underenumeration of children, separating whites and Negroes by sex. Taking registered births in the registration states from April 1, 1925 to April 1, 1927 and deducting deaths of this group up to April 1, 1930 gave an estimated number of survivors aged 3 and 4 on the latter date. After adjusting for interstate migration[3] these data were divided by the number of children enumerated. States with quotients of 1.00 or more were assumed to have complete birth registration, fourteen[4] being used for whites, and five[5] for Negroes. It was assumed that multiplying the enumerated children three and four in any state by the weighted average of these quotients for the selected states allowed for underenumeration and gave the complete number of children of this age. On this basis adding death losses gave the corrected number of births from April 1, 1925 to April 1, 1927 which was divided into births registered to obtain the per cent registered. Allowing for a slight improvement from 1920 to 1930 the per cent of births registered by years from April 1, 1927 to April 1, 1930 was estimated. Dividing registered births by these percentages, and deducting death losses gave the complete num-

[2] Eighteen series of computations have been made recently, for the United States as a whole, in cooperation with the Population Committee of the National Resources Committee. Earlier series include 14 for the United States, two for divisions, and two for individual states; for those published see: Whelpton, P. K.: "Population in the United States, 1925–1975," *American Journal of Sociology*, vol. 34, no. 2 (September 1928), pp. 253–270, ———: "The Future Growth of the Population of the United States," in *Problems of Population*, (G. H. L. F. Pitt-Rivers ed.; London: Allen and Unwin, 1932); Thompson, Warren S., and Whelpton, P. K: *Population Trends in the United States* (New York: McGraw-Hill Book Company, Inc., 1933), ———: "Estimates of Future Population by States," prepared for the National Resources Board, Washington, National Resources Board, December 1934, ———: "Estimates of Future Population by States," Oxford, Ohio, Scripps Foundation for Research in Population Problems (October 1935) (Mimeographed); U. S. National Resources Board: "Report on National Planning and Public Works," Washington, G.P.O., (December 1934), pp. 96–97 (Thompson, Warren S., and Whelpton, P. K.).

[3] The interstate migration of white and Negro women in the childbearing ages was estimated as follows: (1) Deduct from the 1930 census population of each state the net gain through foreign immigration estimated from data in annual reports of the Commissioner General of Immigration. (2) Calculate survival rates for the United States by dividing the 1930 census population in each five-year age period by the 1920 census population ten years younger. (3) Modify these by the ratio of state to United States survival rates shown by the Metropolitan Life Tables for 1929–31. (4) Apply these state rates to the 1920 state populations and adjust the sum of the 1930 survivors to equal the national total. (5) Deduct these figures from the 1930 census in (1) to obtain net gain or loss of women by interstate migration. (6) After testing several values for the fertility during the five years ending April 1, 1930 of women migrating during this period compared with those in the states receiving migrants, 75 per cent was chosen as the most probable ratio. (7) Calculate the number of births to migrating women on this basis, deduct death losses, and raise or lower accordingly the number of children in each state.

[4] New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Michigan, Minnesota, Maryland, District of Columbia, Florida, Oregon, and California.

[5] New York, New Jersey, Pennsylvania, Illinois, and District of Columbia.

ber of children under three as of April 1, 1930. Dividing the complete number of children under five by the census number gave the correction constant for underenumeration, namely 1.05 for whites and 1.13 for Negroes, the latter value also being used for other colored children.

DEATH RATES AND TRENDS

An examination of birth and death data by age indicated that little if any increased accuracy would be obtained by dealing with one-year age periods and time intervals instead of five-year and that the additional labor involved would not be justified. The procedure adopted was to compute death rates by five-year age periods and time intervals for native whites, foreign-born whites[6] and Negroes by sex, and subtract these from unity to obtain survival rates by five-year age periods and time intervals, e.g., the number of native white women living to be 15–19 on April 1, 1935 out of 1,000 who were 10–14 on April 1, 1930. The steps in detail for the population in the 1930 death registration states are as follows: (1) Estimate the deaths for each race and nativity group from April 1 to December 31, 1930 and January 1 to March 31, 1935 on the assumption that the seasonal variation in deaths at all ages applies to deaths at each age. (2) For each calendar year or fraction thereof from April 1, 1930 to March 31, 1935, draw summation curves based on deaths by age at death,[7] and read deaths by age on April 1, 1930, e.g., persons dying between the ages of $43\frac{1}{4}$ and $48\frac{1}{4}$ in 1933 were between 40 and 45 on April 1, 1930. (3) Add deaths from April 1, 1930 to March 31, 1935 by age of persons on the former date. (4) Divide these sums by the number of persons (in thousands) enumerated by the census, except that deaths of children born from April 1, 1930 to March 31, 1935 are divided by the number of births[8] (in thousands) during that time interval. (5) Subtract these five-year-age-period-five-year-time-interval death rates from 1,000 to obtain five-year-age-period-five-year-time-interval survival rates. The death rates for native white males are shown in Table I. Because the death registration states of 1930 contained such a large proportion of the nation's population[9] it was assumed that the age specific rates of this area in 1930–34 represented those of the United States.

With five-year-age-period-five-year-time-interval survival rates obtained according to mortality conditions of 1930–34 the next problem was to determine the changes that would be likely to occur in them

[6] The Division of Vital Statistics did not classify white deaths by nativity after 1932, hence it was necessary to estimate their distribution for later years according to data for prior years.

[7] Special age class is set up for persons born between April 1, 1930 and March 31, 1935.

[8] Registered births plus estimated number not registered (see preceding section).

[9] 95.6 per cent of the native whites, 99.3 per cent of the foreign-born whites, and 92.8 per cent of the Negroes in 1930.

TABLE I

FIVE-YEAR-AGE-PERIOD-FIVE-YEAR-TIME-INTERVAL DEATH RATES FOR WHITE OR NATIVE WHITE MALES, 1900–02 TO 1930–34, AND ASSUMPTIONS FOR 1940–44 TO 1980

Time Interval	Birth to 0–4	0–4 to 5–9	10–14 to 15–19	20–24 to 25–29	30–34 to 35–39	40–44 to 45–49	50–54 to 55–59	60–64 to 65–69	70–74 to 75–79	80–84 to 85–89
White Males in the Original Registration States*										
1900–02	156.5	53.2	16.6	34.4	45.0	60.6	98.4	185.1	357.4	631.9
1909–11	142.1	42.3	14.2	27.4	40.7	60.4	100.3	194.8	370.2	632.2
1919–20	106.2	34.0	15.0	26.8	35.8	48.8	87.5	174.7	354.9	628.0
1929–31	71.5	19.2	10.1	16.7	24.3	46.9	93.8	186.4	362.6	627.5
White Males in the 1920 Death Registration States*										
1919–21	92.7	28.9	14.2	24.5	32.5	44.6	78.4	160.0	335.7	660.0
1929–31	70.1	18.7	10.3	17.8	24.7	45.2	87.3	176.2	351.3	618.1
White Males in the United States*										
1929–31	70.2	18.9	10.3	18.2	24.8	44.6	85.6	174.0	348.7	617.2
Native White Males in the United States										
1930–34†	65.1	16.2	93.	15.7	23.1	40.3	77.7	163.8	343.6	605.5
High‡										
1940–44	52.3	12.5	8.1	13.4	20.1	37.2	74.7	160.5	340.1	601.8
1950–54	45.3	10.9	7.8	12.3	18.2	33.9	69.7	153.7	334.3	598.4
1960–64	41.2	10.3	7.6	11.6	17.0	31.1	64.5	144.1	325.9	595.6
1970–74	39.9	9.9	7.4	11.4	16.2	29.6	62.0	135.4	319.5	594.1
1980–	39.7	9.8	7.4	11.4	16.0	29.2	61.2	133.0	318.2	593.8
Medium‡										
1940–44	50.0	12.2	7.7	12.3	18.2	35.1	72.1	157.1	331.4	601.8
1950–54	41.7	10.5	7.2	10.5	15.1	29.6	62.6	143.1	311.0	598.4
1960–64	36.9	9.7	7.0	9.5	13.0	25.0	52.4	123.1	281.5	595.6
1970–74	35.2	9.3	6.8	9.1	11.8	22.5	47.5	105.0	259.2	594.1
1980–	35.0	9.2	6.8	9.0	11.5	21.9	45.9	99.8	254.6	593.8
Low‡										
1940–44	48.5	11.9	7.4	11.6	17.4	33.0	69.3	153.5	322.6	601.8
1950–54	39.3	10.0	6.8	9.5	13.8	25.4	55.2	132.2	287.7	598.4
1960–64	34.0	9.2	6.5	8.3	11.4	19.0	40.2	101.8	237.1	595.6
1970–74	32.2	8.8	6.3	7.9	10.0	15.5	32.9	74.3	198.8	594.1
1980–	32.0	8.7	6.3	7.8	9.7	14.6	30.6	66.5	190.9	593.8
Males in New Zealand										
1901–05§	91.3	22.9	11.2	20.2	26.1	41.0	74.6	150.9	340.5	601.9
1931‖	42.6	10.2	7.9	13.0	17.7	29.2	61.2	133.0	318.2	593.8
United States Rates for 1980 in Per Cent of New Zealand Rates for 1931										
High	75.0	85.0	80.0	60.0	55.0	50.0	50.0	50.0	60.0	100.0
Medium	82.2	90.2	86.1	69.2	65.0	75.0	75.0	75.0	80.0	100.0
Low	93.2	96.1	93.7	87.7	90.4	100.0	100.0	100.0	100.0	100.0

* Computed from Official Life Tables of the Bureau of the Census. Mexicans are included with whites.

† Computed by the Scripps Foundation for Research in Population Problems according to method outlined in text. Mexicans not included.

‡ See text for basis of assumptions.

§ Computed from life table in New Zealand Official Year Book, 1914, p. 938. For the total population (excluding aborigines) which includes few colored persons.

‖ Computed from life table of Louis I. Dublin and Alfred J. Lotka of the Metropolitan Life Insurance Company.

during future years. Past trends in death rates and life expectancy were wanted as one guide, and were obtained from data in various life tables, extending back to 1900–02 for the original death registration states and to 1789 for Massachusetts.[10] The outstanding facts are the large decreases in death rates occurring at younger ages and the small decreases or occasional increases at older ages. In Massachusetts from 1789 to 1930, 25 years were added to the expectation of life at birth, 13 years at age 20, and 4 years at age 40, but there was no significant improvement at ages above 60. Changes in age specific death rates and expectation of life for the white population of the original registration states from 1900–02 to 1929–31 have been similar to those for Massachusetts. The death rate of white males from birth to 0–4 declined over 50 per cent and from 0–4 to 5–9 nearly 65 per cent. As age increased beyond 5–9 declines rapidly became smaller, amounting to less than 25 per cent at age 40–44 and being negligible at ages over 60 (Table I). Life table data for Negroes have been much less adequate than for whites, and do not go back of 1900. In the original registration states from 1900 to 1920 the expectation of life at birth increased more for Negroes than whites, but little if any improvement occurred in the age periods over 20 as a whole. The more recent trend for Negroes has been downward. Between 1920 and 1930 the life expectancy of males in the 1920 registration states decreased considerably at most ages and that of females increased at the younger ages but declined somewhat between 20 and 75.

As a second guide in determining the future death rates to be used in these calculations it seemed appropriate to study the country with the world's most favorable mortality conditions, namely, New Zealand. Past trends there have been similar to those in the United States, but more progress has been made in lowering death rates at ages below 65 and especially in the 40's and below 10 (Table I). Death losses apparently have been slightly higher than in the United States at ages above 85, but the numbers involved are small, and differences in accuracy of reporting age at death or on the census date may account for part of the excess.

A third type of information, not statistical but helpful nevertheless, comes from the fields of medicine and public health. There is no question but that all the knowledge now available about controlling various causes of death is not being put into practice to the extent that it will be in the future. Furthermore, it is almost inconceivable that additions to this fund of knowledge are suddenly going to cease. To be more

[10] For a summary of these life tables see Thompson, Warren S., and Whelpton, P. K.: *Population Trends in the United States*, p. 240.

specific on the first point, the various serums recently developed for pneumonia are almost certain to come into common use in the future, and lower markedly the death rate from this disease. Likewise the near future should see the inauguration of a public health campaign against syphilis which will produce results comparable to those obtained in the fight against tuberculosis.[11] There is less basis for being dogmatic on the second point, but medical research is sure to continue, and can be counted on to yield valuable information as it has in the past.

Although the foregoing type of information on death rates and their control is helpful in indicating future trends it does not show precisely the course which will be followed, except to those who have implicit faith in the results obtained by extrapolating a time series according to a particular formula. After examining the evidence most people probably would agree in expecting substantial declines from 1935 to 1980 in death rates at ages below 35, but would differ as to the exact amount of these declines. The rapid downward trend of recent decades cannot continue for long without bringing the rates almost to zero, which even the most optimistic do not expect. On the other hand a comparison of United States and New Zealand trends should lead the pessimistic to expect 1980 rates here to be at least as low as present rates there. Opinions probably will vary more widely as to the course of death rates at ages 50 to 75. To the pessimistic the slight downward trend in the United States and the small favorable differential of New Zealand do not point to large future gains. But the optimistic will argue that attention is being centered increasingly on diseases that exact a heavy toll at these ages, and that such causes as cancer, syphilis, and diseases of the heart may eventually be brought under control just as is occurring with pneumonia at the present time. All can agree that unless death rates in middle life are lowered substantially there can not be large gains in the expectation of life at birth. Death rates of native whites at ages under 25 are so low already that if none died before that age and 1930–34 death rates at older ages continued as at present the expectation of life at birth would only be raised from 62.4 to 68.7.

After considering the facts that could be brought together three trends were laid out for native white death rates up to 1980. According to the least favorable assumption—with highest death rates—the expectation of life at birth will be raised from 62.4 in 1930–34 to 67 in 1980,[12] through death rates declining somewhat below 1931 New Zea-

[11] Parran, Thomas: "The Next Great Plague to Go," *Survey Graphic*, vol. 25, no. 7 (July 1936), pp. 405–411; 442–443.

[12] Males and females combined, with male death rates declining slightly more than female death rates at most ages.

land rates at ages below 40, and as low as those rates at older ages (see Table I). The most favorable assumption—with lowest death rates—envisaged somewhat greater improvement in mortality conditions at the younger ages and much more at middle life, with the expectation of life rising to 73 in 1980. The medium trend, which now seems most probable to us, lengthened life expectancy at birth to 70 years, keeping death rates at younger ages nearer the low than the high assumptions, and at older ages about midway between the two. Death rate trends for foreign-born whites, Negroes, and other colored were assumed to be similar to those for native whites, but with slightly larger decreases. The unfavorable differential of these groups compared with native whites was diminished by one-fourth in the high death rate trends, one-half in the medium, and three-fourths in the low.

BIRTH RATE TRENDS

For births as for deaths it was desired to have rates for five-year age periods and time intervals in making the actual computations. Because of the necessity of using ratios of children to women in determining long-time trends of United States birth rates in the past it was decided to use the methodology of the former and divide births during a five-year interval by women living at the end of the interval.

To obtain rates for the base period, births registered from April 1, 1930 to March 31, 1935 in the 1930 registration states were increased to allow for nonregistration, white births[13] being divided by .96[14] and colored births by .86. Using summation curves, the grouping of births by age, color and nativity of mother was changed from age at birth of child to age on April 1, 1935. The number of women in the 1930 birth registration states on this later date was calculated by multiplying the number enumerated in the 1930 census by the five-year-age-period-five-year-time-interval survival rates described above. Dividing births to native and foreign-born white women by the number of women in the proper year and age periods gave preliminary rates for the 1930 birth registration states. Since these states contained 95 per cent of the nation's native white population in 1930 these native white rates were used for the United States (see Table II).

To obtain rates for the other groups several minor adjustments were necessary. Births to Negro women not being published by age of mother it was assumed that their percentage distribution by age of mother was the same as that for colored births, which were 90.2 per

[13] Mexican births were estimated in a few states where they are wholly or partially registered as white, and transferred from white to colored mothers.

[14] These values were obtained in computing the underenumeration of children under five shown above.

cent Negro in 1930–34. Dividing these births by the survivors from the 1930 Negro female population in the birth registration states gave rates for this area. The number of births to Negro women in the United States during 1930–34 was then estimated from the census ratio of Negro children under 1 in the 1930 birth registration states to those in the United States, and a similar ratio based on Negro births during 1933–34. Finally, rates for the birth registration states were adjusted proportionally so that when applied to the survivors from the United States Negro female population of April 1, 1930 they would give this number of births. These rates appear in Table II.

TABLE II

BIRTHS FROM APRIL 1, 1930 TO APRIL 1, 1935 PER 1,000 WOMEN BY AGE ON LATTER DATE*

Nativity and Race	15–19	20–24	25–29	30–34	35–39	40–44	45–49	Σ
Native White Women	65.1	432.1	592.7	509.5	342.1	186.3	49.6	2,177.4
Foreign-born White Women	44.5	490.8	703.3	550.3	389.2	200.0	55.5	2,433.6
Negro Women	174.8	786.4	636.5	471.1	407.4	206.5	67.3	2,750.1
Other Colored Women	266.5	1,199.1	970.4	718.3	621.1	314.9	102.6	4,192.8

* Computed according to method outlined in text.

In the case of foreign-born white and other colored women and their children under 5 it was necessary to consider immigration. The net movement in the five years beginning April 1, 1930 by five-year age periods as of April 1, 1935 was estimated from official data on age of migrants. Arrivals exceeded departures for foreign-born white women up to age 35, but departures exceeded arrivals at older ages, and for other colored women at all ages.[15] For the whites it was desired to deal with women in the United States on April 1, 1930 and births to them both here and abroad. To do this it was assumed that women migrating between April 1, 1930 and April 1, 1935 had the same number of births during this interval in the United States as in foreign countries, or twice the number represented by migrating children 0–4. Births in the United States to foreign-born white women were estimated from births in the 1930 registration states, assuming the 1930–34 relation-

[15] The net movement of women and their children was estimated as follows:

	Children 0–4	Women						
		15–19	20–24	25–29	30–34	35–39	40–44	45–49
Foreign-born White Women	−15,300	7,000	11,800	14,600	400	−1,100	−800	−1,000
Other Colored Women	−800	−1,700	−2,600	−4,500	−4,600	−4,000	−3,300	−2,500

ship to be the same as that known for 1933. These local births were increased by 18,300 births abroad to recent emigrant women and decreased by 1,100 births in the United States to recent immigrant women,[16] and final specific birth rates obtained by adjusting the temporary foreign-born white rates so they would yield this number of births when applied to the survivors on April 1, 1935 of the foreign-born white females enumerated five years earlier (see Table II). In a similar manner, other colored births in the United States were estimated from births in the 1930 registration states, and decreased by 900 to allow for births in the United States during 1930–34 to women emigrating in that interval. Because of the large margin of error in these data for other colored, age specific birth rates were not computed for this group. Instead, those for Negroes were changed proportionally to yield the number of other colored births mentioned above when applied to the survivors on April 1, 1935 of the other colored females enumerated five years earlier minus the net emigration during this time (see Table II).

Since it is not customary to use five-year-age-period-five-year-time-interval birth rates or their sum a brief interpretation may be helpful. The sum of these rates is approximately equal numerically to the sum of annual rates by one-year age periods or five times the sum of annual rates by five-year age periods, the total fertility of Kuczynski.[17] For example, the sum of the five-year-age-period-five-year-time-interval rates and the total fertility rates in the United States during 1930–34 were as follows: native whites, 2,177 and 2,158; foreign-born whites, 2,434 and 2,404; and Negroes, 2,750 and 2,728. The sum of the five-year-age-period-five-year-time-interval rates also indicates approximately the number of births per 1,000 women living to age 50.[18] For native whites this amounts to 2,177, which is equivalent to 2,432 births per 1,000 married women[19] since the last census shows only 10.5 per cent remaining single at age 50. The fragmentary evidence available indicates that about one-sixth of the women who marry are infertile, i.e., bear no children, so the rate per 1,000 fertile women would rise approximately to 2,920, or nearly 3 births to each fertile woman.

Choosing trends which these five-year-age-period-five-year-time-interval birth rates might be expected to follow in the United States dur-

[16] Estimated from 17,400 native born children under 5 on April 1, 1935 permanently departing (most of whom had foreign-born mothers) and the net arrivals of 1,100 foreign-born children under 5.

[17] Kuczynski, R. R.: *The Measurement of Population Growth* (London: Sidgwick & Jackson, 1935), p. 117.

[18] In adding the five-year-age-period-five-year-time-interval rates it is assumed that the fertility at any age of life is the same for women who will die before the menopause as for those who will live through it, which probably is not far from the truth. Fertility and mortality probably are inversely related, other things equal. But actually other things are not equal since both fertility and mortality are inversely correlated with economic status.

[19] Assuming that all single women bearing children marry later on.

ing future years presented more difficulties than the similar choice for death rate trends. Although the experience of foreign countries probably is less helpful in this case than the other, it was believed to merit attention. For this purpose total fertility rates calculated for many foreign countries by Kuczynski[20] were compared with those for the United States. Low as the recent rate of 2,158 is for native whites in the United States, rates for Australia and New Zealand are almost identical (2,195 and 2,151), while those for all the Western European countries and two of the Eastern (Austria and Latvia) are even lower.[21] Wherever the immediate post-war rates and the recent rates can be compared a striking drop is shown, in most cases continuing a slower decline that was going on before the war. Judging from what has happened in other nations, therefore, there is little basis for expecting the downward trend in the United States to end suddenly and a rise to set in. It is true that crude birth rates in several countries (including the United States) were slightly higher in 1934 than in 1933, but reports for 1935 and current months of 1936 indicate that the rise is not continuing, and that neither 1935 nor 1936 rates will equal the 1930–34 average with the possible exception of Germany.

In addition to this international comparison the long-time trend in the United States during past years was desired before making assumptions regarding the future. Because the birth registration area was not organized until 1915 it was necessary to estimate this from census data. The procedure followed was to approximate the number of births in the five years ending on the census date by adjusting children under five for underenumeration, and adding an allowance for death losses. Birth rates by five-year age periods for 1930–34 (Table II) were then adjusted proportionally so that when multiplied by the proper groups of women in earlier censuses the sum of the products would equal the above estimate of births.[22] Implicit in this process is the assumption that the percentage variation in age specific birth rates in the past was the same at all ages. It is almost certain that such was not the case, and that there was a direct relation between age and percentage decrease prior to 1915 as there has been since that time. Nevertheless, lack of data for estimating the differences in trend by age, together with the fact that the same figures for total births would be obtained in any event, appeared to justify this procedure.

[20] Kuczynski, R. R.: *op. cit.*, pp. 122–124.

[21] Denmark 2,413, England 1,504, France 2,240, Germany 1,778, Sweden 1,878, Austria 1,787, Latvia 2,212. The rates for Denmark, France, and Latvia are for years between 1926 and 1930, and do not show the decline which occurred after 1930.

[22] To illustrate: rates for native white women in the 1910 census were obtained by multiplying these women by the 1930–34 rates, dividing the resulting births into the estimate of births to these women during the five years prior to the 1910 census, and multiplying the 1930–34 rates by this quotient.

As would be expected from earlier studies of ratios of children to women,[23] these estimates show there has been a large and almost uninterrupted decline of age specific birth rates since the beginning of the nineteenth century. White rates during 1875–79 were more than twice as large as those during 1930–34, while during 1795–99 they were over 3½ times as large (see Table III). In only one ten-year interval does there appear to have been an increase in these rates (from 1845–49 to 1855–59) every other ten-year interval showing a decided decrease. Although the numerical declines have become smaller as the rates have become lower, the percentage declines in ten years have shown little tendency to diminish, the 18 per cent drop from 1915–19 to 1925–29 being the largest in the series, and the 17 per cent drop in the *five*-year interval from 1925–29 to 1930–34 being nearly as large.

Similar rates for native and foreign-born white women cannot be estimated accurately prior to 1905–09, nor for Negro women prior to 1845–49. Since these dates the decline of native white rates has been somewhat less than that of all whites, that of Negro rates about the same (although concentrated in different decades) and that of foreign-born white rates much more rapid.

Because birth rates are more subject to human control than death rates there is less basis for predicting their future course by extrapolating the local trend during past years, or by accepting the present situation in some foreign countries as the goal that will be reached here at some future time. Recent studies indicate that the practice of contraception is an exceedingly important immediate factor governing the size of the birth rate.[24] Judging from the improvements in the technique of contraception and the wider diffusion through the population of information regarding birth control that have taken place in the last decade or two further declines in birth rates are to be expected. However, a wide number of conditions govern the extent to which birth control is practiced by those acquainted with the methods, and little is known about how or to what degree they may be influenced. As a consequence of the legitimate differences in opinions regarding what is ahead it seems desirable to calculate the future population according to more divergent assumptions of trends of birth rates than of death rates.

[23] Willcox, Walter F.: *Proportion of Children in the United States*, Washington, G.P.O. (1905). Bull. 22.

———: "The Change in the Proportion of Children in the United States and in the Birth Rate in France during the Nineteenth Century," *American Statistical Association Publications*, vol. 12, n.s. no. 93 (March 1911), pp. 490–499.

Whelpton, P. K.: "Industrial Development and Population Growth," *Social Forces*, vol. 6, nos. 3–4 (March–June 1928), pp. 458–467; 629–638.

[24] Pearl, Raymond: "Contraception and Fertility in 4945 Married Women. A Study of Family Limitation," *Human Biology*, vol. 6, no. 2 (May 1934), pp. 355–401.

Stix, Regine K., and Frank W. Notestein: "Effectiveness of Birth Control," *Quarterly Bulletin of the Milbank Memorial Fund*, vol. 13, no. 2 (April 1935), pp. 162–178.

Careful consideration of the information available regarding birth rates and factors affecting them lead us to adopt as the high birth rate assumption an abrupt stopping of the past decline, and a continuation of the 1930–34 values during subsequent years. For the low assump-

TABLE III

BIRTH RATES PER 1,000 WOMEN IN THE UNITED STATES 1930–34, WITH ESTIMATES FOR EARLIER YEARS AND ASSUMPTIONS FOR LATER YEARS, BY COLOR AND NATIVITY*

Year	All White Women†		Native Born White Women†		Foreign-born White Women†		Negro Women		Other Colored Women	
	Birth Rate	Per cent of 1930–34	Rate Birth	Per cent of 1930–34	Rate Birth	Per cent of 1930–34	Rate Birth	Per cent of 1930–34	Birth Rate	Per cent of 1930–34
1789–99	7844	356.1								
1805–09	7798	354.1								
1815–19	7416	336.7								
1825–29	7050	320.1								
1835–39	6667	302.7								
1845–49	5473	248.5					6857	249.3		
1855–59	5536	251.3					6725	244.5		
1865–69	4968	225.6					6239	226.9		
1875–79	4686	212.8					6689	243.2		
1885–89	4042	183.5					5525	200.9		
1895–99	3846	174.6					4867	177.0		
1905–09	3510	159.3	3281	150.7	4510	185.3	4118	149.7		
1915–19	3244	147.3	2961	136.0	4669	191.9	3226	117.3		
1925–29	2650	120.3	2597	119.3	3012	123.8	2855	103.8		
1930–34	2202	100.0	2177	100.0	2434	100.0	2750	100.0	4193	100.0
Low‡										
1935–39	1954	88.7	1940	89.1	2152	88.4	2431	88.4	3635	86.7
1945–49	1685	76.5	1682	77.2	1839	75.6	2066	75.1	2976	71.0
1955–59	1566	71.1	1566	71.9	1692	69.5	1883	68.5	2619	62.5
1965–69	1520	69.0	1520	69.8	1625	66.8	1788	65.0	2407	57.4
1975–79	1503	68.2	1503	69.0	1593	65.5	1733	63.0	2262	54.0
Medium§										
1935–39	2092	95.0	2077	95.4	2314	95.1	2614	95.1	3953	94.3
1945–49	1975	89.7	1969	90.4	2180	89.6	2456	89.3	3655	87.2
1955–59	1932	87.7	1928	88.5	2122	87.2	2379	86.5	3486	83.1
1965–69	1912	86.8	1908	87.6	2089	85.9	2330	84.7	3362	80.2
1975–79	1905	86.5	1901	87.3	2071	85.1	2297	83.5	3264	77.8
High‖										
1935–79	¶		2177	100.0	2434	100.0	2750	100.0	4193	100.0

* The 1930–34 rates are sums of rates by five-year age periods in Table II. See text for method of estimating rates for earlier years and assumptions for subsequent years.

† Mexicans are included with whites up to 1915–19 and excluded in 1925–29 and later years in accordance with current census practice.

‡ Assuming no immigration.

§ Assuming net immigration of 100,000 per year.

‖ Assuming net immigration of 200,000 per year.

¶ Since the birth rates of native white and foreign-born white women remain unchanged the rate for total whites varies only as there are changes in the proportion of native and foreign-born whites. Starting from 2,202 in 1930–34 the rates for future years are as follows: 1935–39; 2,194; 1945–49, 2,186; 1955–59, 2,187; 1965–69, 2,188; and 1975–79 also 2,188.

tion, the past downward trend was continued at a decreasing pace, rates for native whites reaching a level in 1980 at 1,500 births per 1,000 women living through the childbearing period compared with 2,177 during 1930–34 (see Table III). This represents a decline of 31 per cent from 1930–34 to 1980 as compared with 34 per cent from 1905–09 to 1930–34. The 1980 rate is approximately that of England

in 1933, and only a little under that of California and Washington, D.C., in 1929–31. It would be attained if nine-tenths of the women living to age 50 marry and one-sixth of those marrying bear no children as at present, and if the remainder are equally divided into those bearing 1, 2, and 3 children.

For the medium assumption the past downward trend was continued at a slower pace, reaching a level in 1980 at 1,900 births per 1,000 native white women living through the childbearing period. This rate would prevail if present rates for marriage and infertility of married women continued, and if fertile women were about equally divided between those bearing 1, 2, 3, and 4 children. It would represent a decline in rate of 12.7 per cent in the next fifty years compared with a 34 per cent drop in the last 25 years. The United States rate in 1980 would be approximately that of Sweden, and also of Massachusetts, Connecticut, Washington, and Oregon in 1929–31, and significantly higher than the rate of New York and New Jersey. In the low assumption the 1930–34 differentials between native whites and other groups were reduced by 50 per cent, in the medium by 25 per cent.

IMMIGRATION ASSUMPTIONS

Future trends of birth and death rates may have some relation to past trends, but those for immigration are almost certain to be unrelated. Formerly there was little governmental control exercised over immigration, hence the size of the movement varied chiefly with economic conditions here and abroad. Since the World War, however, the attitude has changed greatly. In response to public opinion in this country laws and regulations have been adopted which limit rigorously the number of immigrants admitted. At the same time certain foreign countries which formerly sent millions of persons, e.g., Italy, have developed nationalistic policies which have led to discouraging and even prohibiting emigration to foreign countries. What will happen in the future, therefore, depends primarily on political action, which may be influenced by a great variety of conditions. Under these circumstances the desirable procedure in these calculations seems to be to show the future population according to several assumptions of future birth and death rate trends with no immigration and also with net arrivals of 100,000 or 200,000 annually beginning 1940.[25] By utilizing differences between the with and without immigration series those interested in the effect of movements of larger or smaller numbers may easily obtain the results they wish. In all cases the relative color and age composition

[25] To simplify the calculations the net additions every five years were taken as five times these values (with no allowance for deaths) and the number of native born children 0-4 was increased by an amount equal to the immigrants of that age.

of the immigrants is assumed to be approximately the same as of those entering during 1925–29, but a sex ratio of 122.22 for whites and 150 for other colored is used as being more normal than the excess of females in the actual movement of those years.

THE FUTURE POPULATION

If the three assumptions for the future course of birth rates and three for death rates that have been described are combined in all possible ways with and without immigration, 18 series showing the future population of the United States will be obtained. Only 6 will be shown, the extremes and the middle ground with and without immigration[26] (Table IV). *A* will be referred to as the low series, *D* as the medium, and *F* as the high. According to the low series the population will cease to grow between 1955 and 1960, and from then to 1980 will decline at an accelerated pace. Its maximum size will be about 137,300,000 and by 1980 it will be back to the 1935 figure (Table IV). If the high series is followed growth will continue until after 1980, although at a decreasing rate, and the population on that date will amount to about 185,800,000. At the present time it seems to us that the medium series will be closer to what happens than the high or low, though probably somewhat too high. According to this

TABLE IV

FUTURE POPULATION OF THE UNITED STATES IF FERTILITY, MORTALITY, AND IMMIGRATION FOLLOW STATED TRENDS 1935 TO 1980*

(Thousands)

Year	Low Fertility High Mortality		Medium Fertility Medium Mortality		High Fertility Low Mortality	
	No Immigration *A*	100,000† Immigrants *B*	No Immigration *C*	100,000† Immigrants *D*	No Immigration *E*	200,000† Immigrants *F*
1930‡	122,775.1	122,775.1	122,775.1	122,775.1	122,775.1	122,775.1
1935	127,354.3	127,354.3	127,354.3	127,354.3	127,354.3	127,354.3
1940	131,157.0	131,157.0	131,993.1	131,993.1	132,613.2	132,613.2
1945	134,138.7	134,647.9	136,447.4	136,956.6	138,209.7	139,228.4
1950	136,176.6	137,245.7	140,560.9	141,644.8	143,898.4	146,086.2
1955	137,171.9	138,840.3	144,093.1	145,808.1	149,353.0	152,852.1
1960	137,088.7	139,375.3	146,986.5	149,371.6	154,563.5	159,481.2
1965	136,026.3	138,938.0	149,340.8	152,421.2	159,719.5	166,135.2
1970	134,048.9	137,588.3	151,170.0	154,969.3	164,835.8	172,837.0
1975	131,221.1	135,387.4	152,432.9	156,977.4	169,779.0	179,471.1
1980	127,570.9	132,356.7	153,022.3	158,335.2	174,330.3	185,823.5

* See text for description of trends assumed. The calculated numbers of children 0–4 and hence of total persons are reduced to correspond with underenumeration of children in the census.
† Net annually, beginning with 1940.
‡ Census.

[26] In all cases immigration is assumed to begin in 1940.

series, the population will reach its maximum of about 160,000,000 soon after 1980, and then begin to dwindle numerically.

Some of the changes in composition that will come about if population growth follows the medium series are shown in Table V. Native whites will make up an increasing proportion of the total, but there will be a larger decrease in the proportion of foreign-born whites. Negroes will make a small relative gain and other colored a large one, though they will still constitute less than 4 per cent of the total. The sexes will become more nearly balanced in numbers as time passes, the native white sex ratio remaining almost unchanged at 101 but that for foreign-

TABLE V

FUTURE POPULATION OF THE UNITED STATES ACCORDING TO MEDIUM SERIES* BY COLOR, NATIVITY, AND SEX, 1935 TO 1980

(Thousands)

Year	Total Population		Native White		Foreign-born White		Negro		Other Colored	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1930†	62,137.1	60,638.0	48,010.1	47,487.7	7,153.7	6,212.7	5,855.7	6,035.5	1,117.6	902.1
1935	64,141.4	63,212.9	50,566.3	50,200.3	6,304.3	5,691.7	6,153.7	6,360.6	1,117.1	960.3
1940	66,296.0	65,697.1	53,048.3	52,822.0	5,586.3	5,129.5	6,455.3	6,683.1	1,206.1	1,062.5
1945	68,667.6	68,289.0	55,439.5	55,320.6	5,087.5	4,737.0	6,763.4	7,004.8	1,377.2	1,226.6
1950	70,935.7	70,709.1	57,689.7	57,636.0	4,598.4	4 336.1	7,072.8	7,319.9	1,574.8	1,417.1
1955	72,979.4	72,828.7	59,671.5	59,639.0	4,135.0	3,937.6	7,386.4	7,631.5	1,786.5	1,620.6
1960	74,762.3	74,609.3	61,339.3	61,283.7	3,707.1	3,550.2	7,703.5	7,938.4	2,012.4	1,837.0
1965	76,327.8	76,093.4	62,726.9	62,601.7	3,322.0	3,181.0	8,022.4	8,239.5	2,256.5	2,071.2
1970	77,681.8	77,287.5	63,843.8	63,603.6	2,984.2	2,835.1	8,334.5	8,525.6	2,519.3	2,323.2
1975	78,798.2	78,179.2	64,664.9	64,276.3	2,703.4	2,521.5	8,631.6	8,789.9	2,798.3	2,591.5
1980	79,612.4	78,722.8	65,128.6	64,575.2	2,492.1	2,252.6	8,900.6	9,022.0	3,091.1	2,873.0

* Medium fertility and mortality trends described in text, and net immigration of 100,000 annually beginning in 1940. The calculated numbers of children 0–4 and hence of total persons are reduced to correspond with underenumeration of children in the census.

† Census.

born whites declining from 115 in 1930 to 111 in 1980, that for Negroes rising from 97 to 99, and that for other colored declining from 124 to 108.

The aging of the population that will occur according to the medium series is shown in Table VI. Never again will there be as many children under 15 as in 1935, the number of this age in 1980 being 4,391,200 less than now. The 15–19 age period will reach a maximum in 1940, and the 20–24 in 1945, both being smaller in 1980 than now. At ages 25 to 54 the 1980 population will outnumber the present, though as at younger ages the peak will have occurred previously. This peak in each five-year period, by the way, is composed of those born during 1920–24, the five years with the most births in the history of the nation. Survivors from these births can be traced easily across Table VI, and as late as 1975 are more numerous than those in any other age period in spite of the death losses that have occurred. At ages above 55 the number of persons increases steadily to 1980, and on the whole with a rising

TABLE VI

FUTURE POPULATION OF THE UNITED STATES ACCORDING TO MEDIUM SERIES* BY AGE, 1935 TO 1980

(Thousands)

Age Period	1930†	1935	1940	1945	1950	1955	1960	1965	1970	1975	1980
0– 4‡	12,143.2	10,911.8	11,031.3	11,216.2	11,280.7	11,050.2	10,755.7	10,558.7	10,453.9	10,388.8	10,305.3
5– 9	12,617.4	11,936.0	10,764.3	10,919.8	11,113.1	11,184.7	10,961.4	10,672.8	10,479.7	10,377.6	10,314.2
10–14	12,014.0	12,523.2	11,863.0	10,737.7	10,895.2	11,088.7	11,161.2	10,940.1	10,653.1	10,461.9	10,360.3
15–19	11,561.0	11,910.9	12,424.8	11,840.2	10,726.8	10,885.6	11,079.5	11,152.7	10,934.1	10,649.5	10,459.3
20–24	10,878.8	11,397.3	11,759.9	12,421.4	11,852.2	10,757.4	10,918.8	11,113.5	11,187.1	10,971.6	10,690.5
25–29	9,841.2	10,668.3	11,218.5	11,712.7	12,378.8	11,827.2	10,752.5	10,918.0	11,112.8	11,187.6	10,975.1
30–34	9,127.3	9,581.8	10,466.1	11,091.0	11,596.0	12,266.0	11,732.8	10,678.3	10,847.4	11,043.7	11,119.5
35–39	9,215.8	8,845.7	9,360.0	10,274.0	10,907.6	11,422.6	12,095.7	11,581.2	10,550.4	10,722.7	10,918.3
40–44	7,996.3	8,881.3	8,592.0	9,122.7	10,039.7	10,682.4	11,206.0	11,878.0	11,381.2	10,372.2	10,543.7
45–49	7,047.7	7,619.8	8,525.3	8,283.9	8,820.4	9,736.9	10,389.8	10,925.2	11,598.1	11,122.6	10,140.3
50–54	5,980.3	6,614.9	7,206.2	8,095.8	7,900.3	8,442.1	9,359.2	10,024.9	10,566.4	11,230.1	10,777.3
55–59	4,649.2	5,490.8	6,110.9	6,690.1	7,555.0	7,421.5	7,974.3	8,890.7	9,554.1	10,092.0	10,737.2
60–64	3,754.0	4,119.9	4,888.0	5,465.0	6,023.0	6,849.3	6,781.5	7,338.9	8,239.5	8,906.2	9,436.6
65–69	2,772.5	3,151.9	3,483.3	4,148.7	4,666.4	5,195.0	5,972.6	5,983.5	6,543.2	7,408.3	8,045.4
70–74	1,951.5	2,133.0	2,444.6	2,721.7	3,273.9	3,734.0	4,222.2	4,938.4	5,025.3	5,556.3	6,323.3
75–79	1,107.3	1,312.3	1,450.3	1,678.9	1,891.0	2,312.2	2,686.2	3,098.2	3,687.7	3,794.8	4,218.0
80–84	535.2	601.4	722.6	807.9	951.6	1,097.3	1,375.6	1,637.1	1,914.9	2,295.7	2,372.6
85–89	205.7	216.7	245.8	296.9	332.9	393.6	455.0	572.9	683.6	800.2	962.7
90–94	51.6	57.2	61.5	69.9	84.3	94.7	112.1	129.6	164.1	196.6	229.9
95 plus	14.9	9.8	10.9	11.8	13.2	15.9	18.0	21.3	24.5	31.5	37.9
Total‡	123,464.9	127,984.0	132,629.3	137,606.3	142,302.1	146,457.3	150,010.1	153,054.0	155,601.1	157,609.9	158,967.4
Comparable to Census											
0–4	11,453.4	10,282.1	10,395.1	10,566.5	10,623.4	10,401.0	10,117.2	9,925.9	9,822.1	9,756.3	9,673.1
Total	122,775.1	127,354.3	131,993.1	136,956.6	141,644.8	145,808.1	149,371.6	152,421.2	154,969.3	156,977.4	158,335.2

* Medium fertility and mortality trends described in text, and net immigration of 100,000 annually beginning in 1940.
† Census.
‡ Includes allowance for underenumeration of children 0–4 in the census explained in text.

rate as age goes up. Persons 50–59 will be twice as numerous in 1980 as now, but those over 80 will be over 4 times as numerous.

Making comparisons between 1935 and 1980 on a percentage basis, the proportion of children and youths (under 20) will decline almost one-third from 36.6 per cent to 25.8 per cent, the proportion in the best working ages (20–39) will decrease slightly from 31.8 per cent to 27.6 per cent, the middle age group (40–64) will have a relative rise of over one-fourth from 25.7 per cent to 32.6 per cent, and elders (65 and over) will more than double relatively, jumping from 5.9 per cent to 14 per cent. If persons in the first and last group are considered as dependents and those in the second and third as producers, the number of dependents per 100 producers will decline significantly, from 73.9 to 66.1. Even if the middle aged are counted only half as valuable from a production standpoint as those 20–39 the ratio of dependents to producers will still decline from 95.2 to 90.6.

If population growth follows the low series these changes in composition will be much more striking. But even if the high series is followed the makeup of the 1980 population will differ sufficiently from that of the present so that making adjustments to the new conditions may present serious difficulties.

Although much time and thought have been devoted to these empirical calculations of future population it is fully realized that this does not insure obtaining results which show accurately the growth and composition that will occur. It is hoped, however, that the undertaking is worth while because of the information it may contribute and the thinking it may stimulate regarding the relationship of birth rates, death rates, and immigration to the size and composition of the population in years to come, and also regarding the changes in growth and makeup which now appear probable and which will raise problems of great significance.

THE APPLICATION OF SAMPLING TO ECONOMIC AND SOCIOLOGICAL PROBLEMS*

By A. L. Bowley
London School of Economics

It can hardly be expected that I should have anything new to say on the subject of sampling, since the methods were discussed at a recent meeting of the Statistical Society, since most of my theoretical work on the mathematical aspects of the question have been accessible to students for a long time, and since the results of the field investigations which I have directed or in which I have cooperated have been published.

The theory of sampling is almost co-extensive with the mathematical theory of probability, at least with that region which is covered in Whitworth's *Choice and Chance*. A universe is symbolized by an urn or a group of urns which contain numbers of balls differing only in colour; one or more selections are drawn in accordance with definite rules, and it is asked what is the relation between the proportions by colour in the selections and those in the universe. The problem is two sided—we may know the proportions in the universe, as we know the contents of a pack of cards, and ask what is the expectation of a hand with particular characteristics—the theory of bridge—or we may wish to infer the properties of an unknown universe from the examination of one or more samples. In sociological field investigation the latter is our problem.

It is well to attempt to distinguish biological problems from sociological. In the examination of species the universe may be considered as unlimited, and we are not concerned with the proportions which have different characteristics so much as with the variation of measurable attributes. In Mendelian studies, however, it is the proportions that are important, but we are still dealing with a hypothetical and unlimited universe. Life tables also relate to a hypothetical universe. Most of the investigations involving probability prior to the year 1900 or later were of this character. Quetelet was not concerned with sociological studies so much as with finding illustrations of the normal law of Error.

We are here concerned, on the other hand, with the investigation of the numerical structure of an actual and limited universe, or "population" which is the better word for our purpose. Our problems are quite

* Read to the Study Group of the Royal Statistical Society, January, 1935.

definitely to infer the population from the sample. The problem is strictly analogous to that of estimating the proportions of the various colours of balls in a limited urn on the basis of one or more trial draws.

The first application of this principle to original investigation was, so far as I know, in 1912, when I was asked by a group of persons in Reading how best to use a small sum of money they had for the purpose of investigating the economic condition of the working-class in that town. I recommended the application of the pure method of sampling, in order to obtain valuable results in the time and with the money and other resources available. Then followed the investigations published in "Livelihood and Poverty," in "Has Poverty Diminished?" in parts of the "New Survey of London Life and Labour," in "Merseyside" and in "Work and Wealth in a Modern Port" where Professor Caradog Jones and Mr. Ford followed the same or a kindred plan. As is well known, the process of selection was to take a list of the houses in the area, usually in alphabetical order of streets, and to mark for investigation one in 'n' of the houses in this order. This is very literally the method of stratified sampling, and corresponded to Poisson's scheme of selecting balls from a number of urns in which the colours were in different proportions.

Another group of cases is found when the universe consists of a file of cards or sheets on which data relating to persons, households or other entities are already entered. In 1915 I obtained from the Census Office extracts relating to one family in fifty taken in order from the householders' schedules in a number of Boroughs. The resulting classification of the personnel of working-class families was published in *Economica* in 1921. In the following years Mr. (Professor) Hilton applied a similar method of selection in his studies of the circumstances of unemployed persons. From the bundles of insurance books at the Labour Exchanges one in each hundred was selected, and the details in it were amplified by direct interview with the claimant for benefit. I recommend a careful reading of Mr. Hilton's paper in the *Statistical Journal* of 1924 and of the discussion on it. There have been several other investigations of a similar character carried out and published by the Ministry of Labour. The Census authorities have not yet been persuaded to use the method in this country, with the result that we are still waiting for some of the most important tabulations of the 1931 Census. It is not, I think, generally known that the Japanese, when a great part of the tabulation of their Census was destroyed by the Tokio earthquake in 1923, took a sample of 1 in a 1,000—numbers 500, 1,500 . . . out of 11 million household schedules, and published the results for age and sex groups, size of households, etc., in 1924. The dis-

crepancies between the sample and the complete results subsequently obtained were unimportant and within the margins expected from theory.[1]

I may mention two other investigations by regulated sample in which I was concerned. On the outbreak of war a voluntary Committee was set up to examine the immediate affects on employment. I joined it on (I think) August 5th, 1914. We sent out forms to all firms in London included in the current Census of production, to one in twenty of the Home Office list of factories and workshops, and to City Offices. The principal questions were How many people were employed on July 21st, How many on August 21st? How many enlisted? How many part time? We issued the results on August 29th. This subsequently developed into a weekly or monthly return for the whole country, was taken over by the Board of Trade, and formed the basis for the study of recruitment, exemptions, etc., still if I remember right, in part on a sample basis. To complete this personal account—in 1917–8 returns were obtained by the Ministry of Food monthly from a systematic sample of the millers and bakers throughout the country as to the stocks and use of flour, so as to watch the effect of voluntary rationing, and determine whether there was a sufficient supply of cereals. The critical time was in the unrestricted submarine warfare of the summer of 1917, when the visible supply was for only a few weeks, and the home harvest some months distant.

A sample is of little use unless we know what universe it is a "fair" sample of, and have some means of judging its precision. The nature of the universe from this point of view differs greatly from case to case. In the Japanese instance the universe was the households from which Census returns were made. The unemployed investigation had an even better defined universe, namely that of insured persons making claims for benefit. In the towns' inquiries, the major definition was inhabited houses as enumerated in an accessible list, with the minor definition "occupied by persons designated as working-class under certain rules of classification." The important point is that the universe always implies the existence of a list of units or its equivalent. This list often does not correspond exactly to the universe that we really desire to investigate; for example we may be interested in unemployed persons independently of whether they are insured or not. It is further limited in many cases by the virtual inclusion of a clause such as "units about which information was obtainable." The importance of this is evident if we are dealing with budgets of expenditure. When the number of

[1] See *Bulletin de L'Institut International de Statistique*, Tome XXV Deuxieme Livraison, p. 121, Tokio Meeting, 1930.

defined units for which information is lacking is relatively small, we can consider the maximum effects of their exclusion, e.g., in the towns' inquiries we can compute the effect on the percentage classed as in poverty on the assumption either that all or that none of the excluded were below the poverty line, or assume that the proportion was the same in the unknown as in the known; or we can use supplementary knowledge to make a closer estimate. But on any of these plans we lose a great deal of the possibility of measuring the standard or other deviation of the estimate.

This possibility depends primarily on every one of the defined units having an equal chance of being included, which again depends on the existence of a defined and catalogued universe. Thus in *Economica* No. 1 there is a comparison by Miss Hogg of the number of persons dependent on women on the basis of the towns' inquiries, where the universe is defined, and of other inquiries made in sporadic fashion from imperfectly defined universes, in some cases with a strong bias to include women with dependents rather than without. When we have secured the essentials that the universe is defined and every member of it has an equal chance of inclusion, or that the chances differ in a known way from one section to another, as did the sampling factors in the New London Survey, then the working out of the standard deviation of the results depends entirely on mathematical formulae, which differ according to whether the selection was made purely at random or was stratified, or was representative etc., and to whether attributes or variables are in question. On these formulae I limit myself to one or two remarks. In my experience by far the most important factor is the universal $1 \div \sqrt{n}$ where n is the number of units included in the sample. Of next importance is p, the proportion in the universe having the attribute in question, or s, the standard deviation when we are considering variates. If we take simply $\sqrt{pq} \div n$ or $s \div \sqrt{n}$, we err usually on the safe side of overestimating the standard error of our estimate; for stratification reduces the error, as does the fact that the universe is finite, as does also the introduction of controls in a representative sample. In none of the investigations with which I have been concerned, nor in any of the artificial experiments I have made, have these factors been of importance, except in that they have guarded against underestimating the error. But, of course, there are cases where they increase the precision considerably, and then they should be estimated and given their due place in the formula.

How great should 'n' be? Since the labour of tabulation increases more rapidly than n, owing among other things to the greater difficulty of checking the work, and it is important to save expense and still

more important to save time, we ought to be prepared to answer this question. We can usually form some preliminary idea of the magnitude of p or s in the universe, and we can decide what precision we wish to attain. Thus if we expect p to be about .3, and we wish the standard error of the estimate to be as small as .01, so that the answer is of the nature 30 ± 1 per cent, then the solution is given by $.01 = \sqrt{pq \div n}$ so that $n = 2{,}100$.

In the New London Survey n was about 30,000, and the percentage of working-class families in poverty could have been stated as $9.8 \pm .17$ so far as the error due to sampling was concerned. This was certainly as large a sample as was necessary, for it is useless to labour over the farthings when the pounds are uncertain. The different reasonable definitions, the ambiguity of Booth's definition, the lack of completeness in the returns and their doubtful accuracy in some cases, give occasion for a much wider limit of doubt than this .17.

I suggest that 1,000 is often a reasonable number to take for n, though of course, no rule can be laid down. This gives a standard error of p as .014 or 30 ± 1.4 per cent when $p = .3$, which may be reduced by stratification.

In my experience the standard error of a *variable* is small. Thus in the Eastern Area in the New London Survey the size of working-class families made a frequency group whose average was 3.69 and standard deviation about 1.7. If the sample had been only 1,000 the standard error of the estimate would have been $1.7 \div \sqrt{1{,}000} = .06$, which is sufficiently small for many purposes.

The analysis of as small a pack as 1,000 is fairly rapid, and the expense and labour of collection is not very great; the number is also sufficiently large to ensure that all sections are included, and to neutralize chance errors in tabulation.

The importance of the rule of equal chances of inclusion needs emphasis, for it is easy to transgress it accidently. Of course, if we only include the obvious or easy, we are limiting our universe, and I have always tried to avoid this by strict instructions that all the units selected in advance, and no others, should be reported on; when a house named proved to be uninhabited the next house on the left was to be taken. Since the mere fact that a unit numbered 1 may occupy that position owing to some attribute—it might for example be a corner house—the numbering of the list began a little after the beginning. The Japanese you may have noticed began at number 500. In Mr. Hilton's first inquiry an error was introduced by choosing the first comer to the Labour exchange in each packet of 100 books for interview, instead of deciding on the actual person beforehand. I have found

that the slightest departure from the rule may have serious results in introducing an unknown bias.

It is important to include questions that can be checked from other sources. Thus in a town sample the results should agree with those from the Census, the Education Authority's statistics, etc. If not, there is evidence of imperfection in the organization of a sample. In Reading, however, I found that I had to use the sample to correct the public information I received. The Education Authority gave me the average number of attendances, instead of the number on the school registers.

I do not propose to discuss the relation of the information afforded by the standard deviation to the inverse problem of inference to the universe, because that has recently been the subject of two meetings of the Statistical Society, the first of which is already published, and because it is too difficult to deal with briefly or non-mathematically. I will only say that as one handles an increasing sample one finds that the estimates converge within progressively narrowing limits, and as they become stabilized the natural man has more and more confidence in their adequacy, though his degree of confidence may not be proportional to any mathematical chance.

I pass on to cases where we cannot catalogue the universe, or have access to any unit we wish, or perhaps not even define the universe satisfactorily, as is the case in the realm of retail prices.

Here we have no theory of probability to help us to compute the standard error of the results, since the whole basis of the theory rests on known chances of inclusion or selection. Perhaps there is an exception in the formation of index numbers of prices, if we are justified in assuming that changes of price are uncorrelated with the definableness of the article or the accessibility of a record of prices. Sometimes we can assert with some plausibility that we are drawing at random from a great universe, and that the objects that we happen to find are not significantly different from those that elude us. Again, we may have good reason to think that absence of information is not correlated with the size of the quantity we wish to measure. For example—I have recently examined the cards of the New London Survey, with the intention of relating the number and ages of children in a family with the age of the mother and the occupational status of the father. In a considerable proportion of the cards the age of the mother is not stated and in many others it is obviously guessed as the apparent age; in fact, the investigators were instructed only to press the question of age for persons under 21 or over 60. So far as I can judge absence of information had more to do with the zeal or tact of the investigator than with anything connected with the number of children or the occupation of

the father. But here, as is often the case, the tabulation of the returns throw light on the adequacy and impartiality of the data. The ages congregated at particular numbers, not always round numbers, and this was the case in each grade of income I took. There appeared to be roughness and inaccuracy, but no bias. Apart from this the results showed the kind of regularity in increasing or diminishing numbers as one went up the age scale, and the diagrams representing the results showed the degrees of resemblance and difference that might be expected. Tabulation is usually a dull and tedious job, but there is a certain interest in watching the entries accumulating in a cross table and seeing the gradual growth of continuity out of randomness. When the results take the form of a regular frequency curve, and especially if we have reason to expect a normal curve and find it, we have good reason to suppose that we have measured satisfactorily a real entity. Thus the distribution of price changes or their logarithms on a normal scale gives a great deal of support to the validity of an index-number. In such cases the computation of a standard error is reasonable. But still in the absence of the pure conditions of sampling we are left in doubt as to what in fact is the definition of the quantity that we have successfully measured.

In general, sampling in an unregulated way is not necessarily useless but it can only yield tentative or suggestive results; their significance is a matter of judgment not of measurement, and there is a very great risk that the collection was biased, whether intentionally or not.

CORPORATE EARNINGS ON SHARE AND BORROWED CAPITAL IN RATIOS OF GROSS INCOME (1918–1935)*

By Leland Rex Robinson

There appeared in the Journal for March, 1934, an article of the same title whose charts and table contained ratios of earnings for the entire post-war period through 1932, the year marking the low point in the depression which was well under way by the end of 1929. It is now possible to carry forward these figures through 1935, visualizing to this extent the course of revival during three years of better times, and comparing its tempo with that of the improvement which set in after 1921 when the first post-war depression scraped bottom.

For a technical discussion of the statistical methods used, their advantages and limitations, and other work in somewhat similar fields the reader is referred to the above-mentioned article by the same author. Here the briefest recapitulation must suffice.

From the standpoint of the investor, the business man, and the banker, the crucial question in connection with any undertaking is its capacity to convert the raw material of gross income into the finished product of net profit on capital employed. This capital includes both borrowed capital and share capital, and gross income comprises interest and dividends received on securities owned as well as revenues from ordinary operations. "Net profit" as used in Table I and the Charts, differs from "net income" in the ordinary sense of earnings on share capital. "Net profit" as here employed is built up by adding to "net income" (after deduction of taxes) all interest paid by the corporation on funded or unfunded debt.

It is evident that ratios of net profit to gross income (where net profit is taken as earnings, after taxes, on all capital employed, both borrowed and share, over the indicated period) are a more realistic gauge of business performance than are ratios of net income (taken as earnings on share capital only). With the former, changes in capital structure, such as alterations in proportions of borrowed and share capital, do not directly affect the ratios of earnings to gross income. With the latter these extraneous factors do have a direct and sometimes important effect upon such ratios from year to year. In other words, ratios of net profit to gross income would appear the better measure of busi-

* Revision of a paper presented at the Ninety-seventh Annual Meeting of the American Statistical Association, New York City, December 30, 1935.

TABLE I

RATIOS (PER CENT) OF NET PROFIT TO GROSS INCOME[1]

		1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935
Total	All corporations[2]	6.5	6.5	4.0	0.1	5.1	5.3	4.5	5.3	5.3	4.6	5.3	5.6	2.5	−0.3	−2.8	1.3		
	Representative corporations[3]	9.5	8.5	7.9	2.6	8.4	9.0	8.7	10.0	10.0	9.5	10.5	11.1	7.2	3.6	−0.7	4.3	5.7	7.1
Mining and petroleum	All	9.3	5.5	7.3	−4.0	4.1	2.8	2.0	7.5	8.8	4.3	7.1	9.1	2.8	−6.0	−7.5	−4.6		
	Representative	19.5	12.3	12.2	1.8	9.5	8.6	9.1	12.8	12.8	7.8	13.0	15.6	7.2	−3.7	0.7	4.2	6.4	10.1
Total manufacturing	All	6.7	7.5	4.9	0.5	6.9	6.9	6.0	6.9	7.0	6.0	7.0	7.6	3.8	0.7	−2.7	2.3		
	Representative	8.5	8.3	7.7	3.3	8.6	9.6	9.2	10.0	10.0	10.7	10.9	11.7	8.5	5.4	−2.5	5.1	6.1	7.7
Food products, beverages and tobacco	All	4.2	3.6	2.3	1.1	4.4	4.7	4.5	4.0	4.6	4.2	4.6	4.8	4.2	3.2	2.5	3.9		
	Representative	3.7	5.0	6.6	−1.5	8.6	10.3	10.3	8.6	8.3	8.5	9.2	9.5	8.5	8.4	9.2	10.1	10.6	7.7
Textiles and their products	All	6.4	9.6	3.1	2.5	7.1	6.7	2.7	4.5	2.3	4.3	3.2	2.6	−3.1	−4.0	−6.4	2.7		
	Representative	10.7	12.0	9.7	7.0	7.2	9.1	2.3	3.8	6.4	8.4	8.7	7.5	−1.1	−0.7	−9.0	6.0	1.4	1.7
Leather and its manufactures	All	5.4	8.4	−1.5	−2.5	5.0	3.0	3.3	3.5	3.2	4.6	3.4	2.7	−1.2	−2.6	−4.5	2.7		
	Representative	7.9	7.3	3.3	5.0	9.1	7.7	8.7	8.6	7.7	9.7	8.7	8.4	7.3	7.1	5.6	7.4	6.6	6.3
Rubber products	All	7.4	8.8	0.3	−11.6	4.4	4.7	5.8	9.5	4.6	5.5	2.0	3.4	−1.5	0.0	−1.9	2.8		
	Representative	9.2	9.9	5.2	−13.9	7.9	7.1	9.4	10.7	5.0	8.9	2.3	5.8	−0.2	1.4	−0.3	5.1	4.6	4.5
Paper, pulp and products	All	6.7	9.0	10.0	0.4	6.3	7.4	6.4	7.5	7.8	8.1	8.3	8.2	6.1	2.4	−2.4	4.0		
	Representative	....	....	....	4.7	11.4	15.3	10.5	11.0	9.9	9.0	10.5	11.4	7.3	3.3	−0.2	3.4	6.4	7.7
Printing, publishing and allied industries	All	4.9	7.6	6.8	4.9	8.8	7.4	7.6	7.5	7.9	7.7	9.1	8.8	7.0	3.4	0.1	2.9		
	Representative	−5.3	−3.2	2.2	9.6	6.9	7.8	6.4	7.8	9.3	15.5	16.3	16.5	14.6	10.1	−1.7	−1.4	3.0	5.4
Chemicals and allied products	All	6.5	7.8	5.5	1.3	9.3	7.7	8.6	10.2	11.3	7.2	11.5	8.8	6.0	3.7	2.8	3.8		
	Representative	7.0	8.8	9.8	6.4	15.4	15.5	12.1	12.4	14.3	15.6	17.9	19.2	15.7	13.5	15.5	15.4	15.6	19.5
Stone, clay and glass products	All	8.4	9.6	8.9	4.6	9.9	12.4	10.5	10.6	10.3	8.3	8.9	8.4	3.9	−1.6	−11.6	−1.0		
	Representative	....	....	29.7	11.3	11.8	14.4	20.2	22.4	18.8	16.8	19.0	17.2	16.1	4.2	−19.3	−3.3	8.2	8.2
Metals and their products	All	8.8	9.9	7.6	−1.4	7.6	7.9	7.4	8.3	8.9	7.0	8.2	9.1	4.6	−1.6	−12.2	−0.9		
	Representative	9.0	8.6	8.6	6.3	8.5	9.7	9.0	10.4	11.3	11.2	12.1	12.8	9.5	4.5	−8.8	2.7	4.8	8.1
Trade	All	5.7	5.0	2.0	0.3	2.9	3.3	2.7	2.9	2.5	2.6	2.8	2.2	0.5	−1.1	−2.7	0.4		
	Representative	6.1	6.5	3.2	1.0	6.8	7.0	6.7	6.9	6.6	7.0	6.7	5.6	3.9	3.5	1.7	3.1	4.6	4.4

[1] Percentage of gross income available for interest and dividends after deduction of all taxes.

Net profit is used in the sense of earnings, after all operating and other costs and taxes, on all capital employed, including capital borrowed on long and short term. In other words, "net profit" as here used is equivalent to "net income" in the commonly employed sense (i.e. earnings on share capital) after deduction of taxes, with all interest paid added back in again. As proportions of borrowed capital vary from company to company, from group to group, and even from year to year, the ratios to gross income of net profit in this sense have more significance as a measure of efficiency and earning power than ratios based upon net income which is arbitrarily affected by changes in the volume and proportion of borrowed funds used in the business.

[2] These figures are computed from *Statistics of Income*, Bureau of Internal Revenue. They include only those categories given in the table and corresponding to the categories of representative corporations.

These figures are based upon analyses of reports of leading corporations. See Table II.

TABLE II

AVERAGE NUMBER OF CORPORATIONS FOR WHICH INDIVIDUAL RETURNS WERE ANALYZED AND AVERAGE GROSS INCOME AS A PERCENTAGE OF THE GROSS INCOME OF ALL CORPORATIONS IN THE GROUP REPRESENTED

Industry Group	Average Number	Average ratios (per cent) gross income to gross for all corporations of group
Total	186	10.7
Mining and petroleum	41	42.9
Total manufacturing	118	11.9
Food products, beverages and tobacco	25	7.5
Textiles and their products	13	2.6
Leather and its manufactures	5	13.3
Rubber products	8	57.8
Paper, pulp and products	6	2.9
Printing, publishing and allied industries	5	3.4
Chemicals and allied products	10	2.2
Stone, clay and glass products	3	3.0
Metals and their products	43	24.1
Trade	27	5.3

ness efficiency, considered of course from a purely acquisitive viewpoint.

From another angle it seems wise not to omit such earnings as accrue to borrowed funds in computing the percentage of gross revenues coming through in the form of net. Only by taking earnings on all capital employed can the long-run capacity of enterprise to attract and wisely utilize savings be tested. To the extent that capitalization assumes the form of debt, net income on share capital alone must reflect the upward and downward leverage effects of prior lien fixed cost capital, thus distorting and magnifying any true picture of the ability of business to increase earnings during good times and its tendency to drop them during bad times.

Of course, earnings upon capital invested in the business are for this latter purpose a better indication than ratios of net to gross income. Capitalization, however, is sometimes as much a reflection of established or prospective earning power as it is of funds actually at work in the business. In view of the devices of modern accounting and the confusion of legal with economic principles in write-ups, write-downs, surplus items, par and stated values, there is a degree of arbitrariness in statements of capital and in changes therein which does not appear in most figures of gross income, despite limitations in the accuracy of the latter.[1] It is interesting to observe, however, that aggregate capital invested in corporations apparently not only gravitates toward their gross income but tends to vary with it, so that the percentage which net bears to gross is a rough indication not only of earning power on capital employed, but also of changes therein.[2]

[1] See this JOURNAL, vol. 29, (March 1934), p. 43.

[2] *Ibid.* page 43, and bottom Chart I, page 44. An interesting conformation of this fact is found in figures appearing in the "Special Survey" ("Analysis of Composite 1935 Balance Sheet and Income

The principal source of figures on American corporate income is of course the annual volume on *Statistics of Income*, published by the Federal Bureau of Internal Revenue. While these statistics are by far the most complete and accurate available, they are nevertheless two to three years late in publication, and throw little if any light upon current conditions. Therefore, in addition to using the Federal *Statistics of Income* it has been necessary to develop series of comparable corporate statistics based upon analyses of the returns of individual corporations.

The number of individual representative corporations whose published reports may be utilized for this purpose is limited by reason of the fact that the great majority of American corporations have not been in the habit of publishing figures of gross income. However, it has been possible to pick out a substantial number of leading and representative corporations which do give the necessary data in their current reports, and to group these corporations into the same categories as those which are presented in the Federal figures. In this way it is possible to compare the fluctuations in ratios of net profit to gross income in the two series. The results of this study are spread out in Table I. The average number of representative companies in each group, and the average percentage which their gross income bears to the gross income for all corporations in each corresponding category as set forth in the Federal *Statistics of Income* are shown in Table II.[3]

The data in Table I are presented in graphic form in the following charts. In all the charts there will be noted a substantial degree of conformity in the movements of the ratios of both series in the period from 1918 to 1933, the latest year for which complete Federal statistics

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Account") of Standard Statistics Company, June 12, 1936. Here (page 2) it is noted that a total of 393 domestic corporations received an average return (fixed charges plus net income) of 6.5 per cent on their invested capital for 1935, as compared with 4.6 per cent in 1934. Of these 393 companies whose reports are in sufficient detail to permit "composite comparative analysis" only 219 gave such figures as "to justify an analysis of sales results." By the latter companies 6.2 per cent was earned on sales for 1935 and 4.4 per cent in 1934. The author's figures of the ratios of net profit to gross income for "representative corporations" (see Table I and Chart I in present article) give 7.1 per cent for 1935 and 5.7 per cent for 1934. The higher level of the latter figures, as well as the slower rate of increase from 1934 to 1935, may be accounted for (apart from lack of identity in the corporations analyzed) by the fact that the Standard Statistics figures of earnings on sales are computed from net income (after interest paid), thus introducing the leverage factor which is based upon capital set-up and which does not appear in the present study.

[3] Obviously the term "representative" applies less to certain groups than to others. In "stone, clay and glass" there are but two companies in the "representative" category and consequently the correspondence of their ratio movements to those of the inclusive government group is less satisfactory.

In utilizing the categories of corporations given in *Statistics of Income*, the author has discarded the following: "agriculture and related industries" (as corporate activity is not typical of agriculture); "finance" (because of wide diversity of non-comparable activities, such as banking, insurance, real estate, stock-broking, and holding company, included therein); "transportation and other public utilities"; "construction"; "forest products"; and "service-professional, amusements, hotels, etc." His figure for "all corporations"—both for representative companies and corporate activity as a whole, as reflected in *Statistics of Income*—is made up, therefore, of all the categories except those omitted as above mentioned.

have been issued. In certain of these groups the conformity is so close that the ratios of net profit to gross income for all corporations may be forecast with a reasonable degree of assurance by bringing up to date the ratios for individual representative corporations in the same categories.

Certain observations suggest themselves in an examination of the table and charts:

(1) Corporations as a whole show a surprising degree of regularity in the proportions of their gross income available as net earnings on total capital employed, including borrowed capital, in the years 1922–1929, during which period such ratio of gross available for net profit kept within 4½ to 5½ per cent, and averaged about 5 per cent. It is significant that in 1928 and 1929 this percentage was only a fraction of one per cent higher than in 1922, and was almost exactly the same as in 1923, 1925, and 1926, a slight drop being registered in 1924 and 1927.

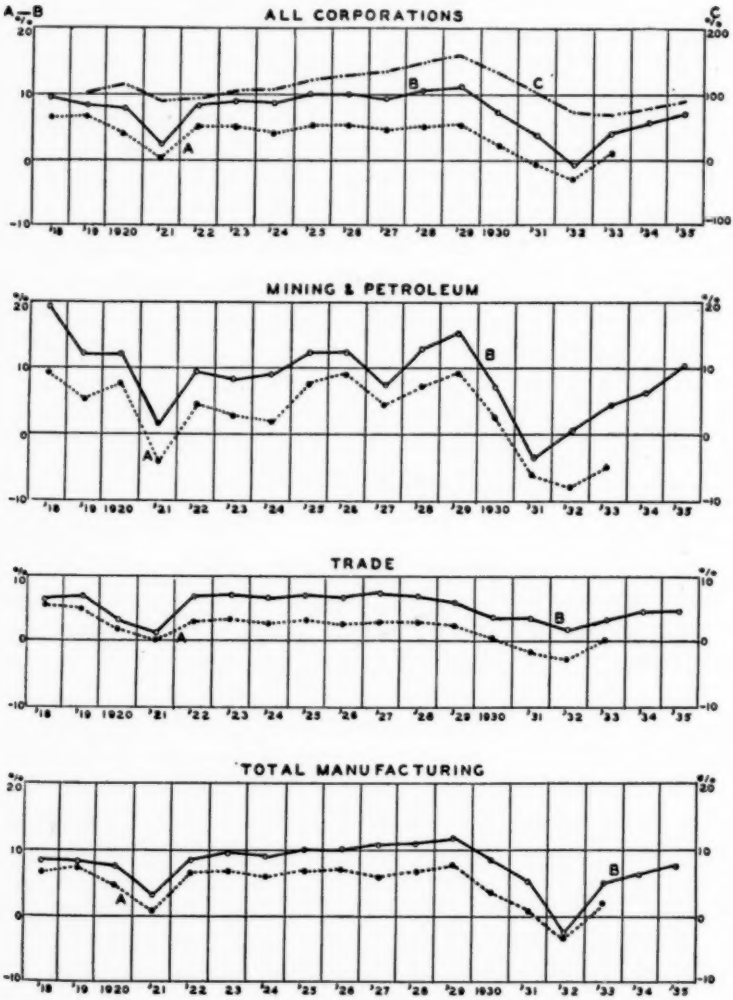
The representative series for all corporations has shown the same broad variations from year to year, but these companies—being in general the larger and more successful units—register a higher percentage of gross available as net earnings, with a gradual upward trend discernible between 1922 and 1929, interrupted in 1924 and 1927. The ratio was slightly less than 9 in 1922, slightly less than 11 in 1928, and a little over 11 in 1929. While an increase in the percentage is shown from 1927 to 1929, it is by no means as great as might have been expected, in view of the mounting gross earnings in the latter years of the "New Era" prosperity.

Both series dropped sharply from 1929 to 1932 during which year, for the first time in the entire post-war period, the nation's corporations were earning less than nothing. Corporations in the representative series registered a marked upturn from 1932 to 1933 in their ability to convert gross into net, while the Federal statistics available only through 1933 show the same trend. The similarity of trend for the two series during the fifteen years since 1918 in which performance of the representative corporations may be compared with that of all corporations in the categories given makes it probable that when, two or more years hence, the Federal figures for 1935 are published, there will be shown from 3 to 4 per cent of gross transformed into net for corporations as a whole (see footnote 3) as compared with 7.1 per cent for representative corporations shown on Chart I.

(2) The dependence of corporate earning capacity upon volume of business is graphically depicted in the charts. Not only does gross income increase in years of prosperity, but there is also a tendency, often

CHART I

RATIOS OF NET PROFIT TO GROSS INCOME



A: Ratio of net profit (amount available for interest and dividends after deducting all taxes) to gross income for all corporations in all categories represented—*Statistics of Income*.

B: Ratio of net profit to gross income for representative corporations in all categories represented—reports separately analyzed.

C: Movement of bank debits for cities outside New York. (Monthly average for each year. Index: 1919=100.)

marked, for the percentage of this gross income coming through into net profit to rise. The opposite is true in the "years of the locust." The accentuated effect upon common stockholders of these wide swings in over-all earning capacity hardly requires comment these days.

This rough relationship between ratios of net profit to gross income and aggregate volume of business expressed in dollar amounts is visualized in the broadly similar movements of bank debits for cities outside New York (line (C) at the top of Chart I) and the earnings ratios for all corporations and for representative corporations. Variations of bank debits from a 1919 base are here taken as an approximate gauge of the trend of gross corporate receipts.[4]

(3) Recovery from the depths of 1932 has been much less rapid—in so far as ratios of net to gross convey the story—than was the upturn following the nadir of the first post-war depression in 1921. During 1922 ratios of net to gross, for both the representative series and all corporations regained the approximate position which might be considered their long-term normal. On the other hand it would appear that not until 1936—four years after the "low" of the second post-war depression—will American corporations have recovered their reasonably-to-be-expected ability in converting gross income into net profit on capital employed.

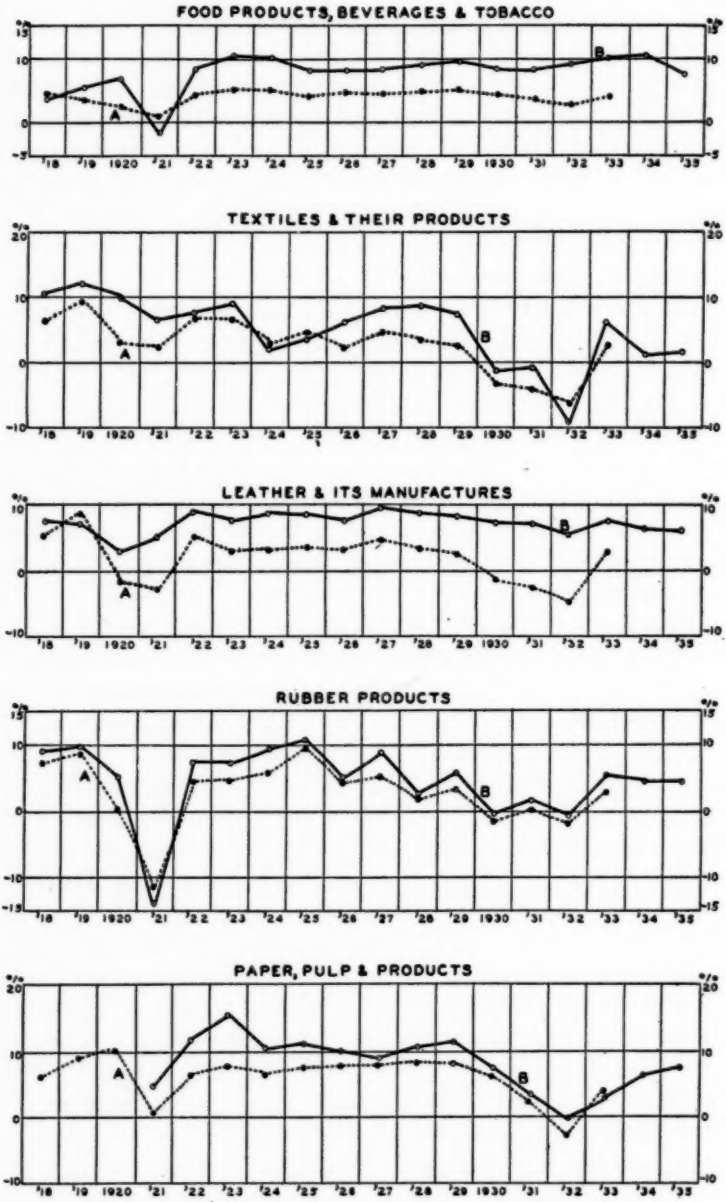
(4) Ratios of net profit to gross income showed a high degree of regularity in Total Manufacturing, and here, as well, the two lines move practically simultaneously, the principal exception being in 1927. For all corporations the ratio was less than 1 per cent higher in 1929 than in 1922, the average for this period being about 7 per cent, with slight decreases in 1924 and 1927. Again it may be remarked that the increase in ratio from 1927 to 1929 is by no means as great as might have been expected in the boom preceding the present depression, and serves to point out the lesser degree of efficiency than is commonly supposed to have characterized industry in those years. The plunge from 1929 became even more precipitate from 1931 to 1932 (for representative corporations); and in the latter year the two series were close together in the No-Man's Land of algebraic negatives. The recovery in 1933 was sharp for both series, and for representative corporations in Total Manufacturing the present year will probably mark a restoration of normal post-war earning capacity in converting gross income into net profit.

(5) Among the different groups given in the table the greatest degree of stability from year to year is to be found in Trade, and in Food Products, Beverages and Tobacco, Chart II. In the latter the ratio for

[4] *Ibid.*, p. 47.

CHART II

RATIOS OF NET PROFIT TO GROSS INCOME

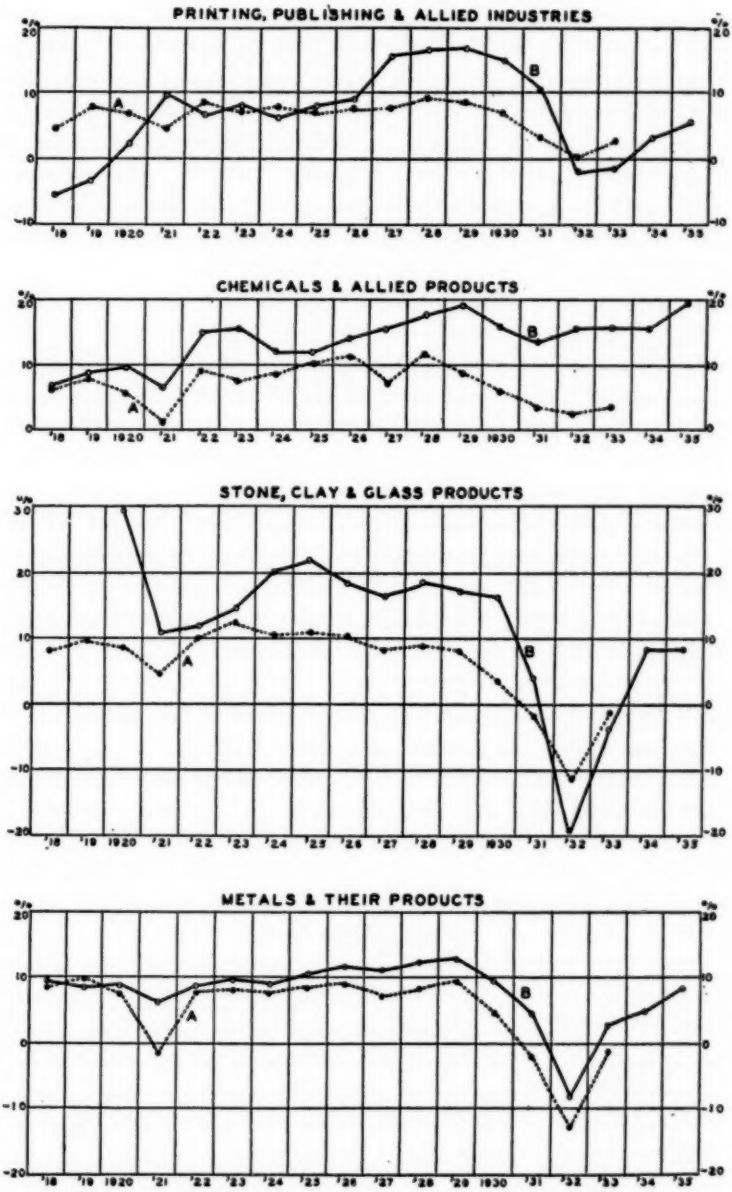

FOOD PRODUCTS, BEVERAGES & TOBACCO
TEXTILES & THEIR PRODUCTS
LEATHER & ITS MANUFACTURES
RUBBER PRODUCTS
PAPER, PULP & PRODUCTS
%
A
B
'18 '19 1920 '21 '22 '23 '24 '25 '26 '27 '28 '29 1930 '31 '32 '33 '34 '35

A: Ratio of net profit (amount available for interest and dividends after deducting all taxes) to gross income for all corporations—*Statistics of Income.*

B: Ratio of net profit to gross income for representative corporations—reports separately analyzed.

CHART III

RATIOS OF NET PROFIT TO GROSS INCOME


PRINTING, PUBLISHING & ALLIED INDUSTRIES
CHEMICALS & ALLIED PRODUCTS
STONE, CLAY & GLASS PRODUCTS
METALS & THEIR PRODUCTS
A
B
'18 '19 1920 '21 '22 '23 '24 '25 '26 '27 '28 '29 1930 '31 '32 '33 '34 '35

A: Ratio of net profit (amount available for interest and dividends after deducting all taxes) to gross income for all corporations—*Statistics of Income.*

B: Ratio of net profit to gross income for representative corporations—reports separately analyzed

all companies is practically the same in 1929 as in 1922–1923, and it varies less than 1 per cent in the interim; while, for representative corporations in the same group, the ratio is almost exactly the same in 1931 as in 1922. In Trade there is a general downward trend, since 1922, in both the representative series and that for all corporations.

Corporations engaged in Trade suffered an elimination of their earning power in 1931 and 1932, but by 1933 had reached the black again. Representative companies in this group, however, showed earnings through the depression's depths and seem to have reached in 1934 and 1935 a stable ratio of earning power somewhat lower than obtained from 1922 to 1929.

Companies in the Food Products, Beverages and Tobacco group were comparatively little affected by the depression in ratios of net profit to gross income. The percentage carried through to net by representative corporations in this category reached, in 1934, the high points of 1923 and 1924, but declined in 1935. The charts show why shares in companies of this category are often called "resistance stocks" by investment bankers.

(6) One conclusion, among others, derived from these charts is that ratios of net profit to gross income suggest a long-term post-war downward trend in Textiles, and Rubber Products; a general upward trend in Chemicals and Allied Products; and a high degree of irregularity from year to year in Mining and Petroleum.

Apart from whatever light research of this kind may throw upon business movements in general, it is also of practical use in studying the performance of individual companies against the background of group experience. Any such application of this method, however, easily leads to unwarranted conclusions unless the characteristics and peculiarities of each company are taken into consideration, and the groupings are essentially homogeneous in character.

THE PRACTICAL SIDE OF TRADE ASSOCIATION STATISTICS

By C. W. Halligan
The Rubber Manufacturers Association, Inc.

The collection and publication of statistics in most industries involves many problems of a practical and mechanical nature which must be reckoned with to insure the reliability, comparability and prompt distribution of facts for the guidance of the industry. It is the purpose of this article to present this phase of statistical work.

Trade association statistics may be divided into two general classes, first, the basic statistics for the industry which are readily obtained by individual companies from their existing accounting or statistical records, and, secondly, the more detailed statistics which are not regularly compiled by all members of an industry because of the clerical cost and effort required to compile them. In the first class may be grouped general sales statistics, statistics dealing with the raw materials utilized in the manufacture of the completed products and general labor statistics, such as the total number of employees and total payrolls. In the second class may be grouped the more detailed sales statistics by product classes and sizes, as well as production, shipments and inventory figures, capacity statistics and cost and special labor statistics.

There are very few industries which have any difficulty in securing fairly reliable information in the first group, for practically every company, regardless of size, must maintain some record of sales at least in dollars, and from their payroll records are able to ascertain, without any additional effort, the number of employees and also the total wages paid. This type of information is so fundamental that most companies in any industry desire such basic data to compare their trends and volume with the industry totals, and as a guide for the establishment of sales' policies. Some companies, however, do not feel justified in maintaining a clerical staff large enough to classify statistical data in the form desired by the majority in the industry, even though they may desire the final information if it could be secured without the expense of contributing information themselves. This attitude we find is one of the chief obstacles to the compilation of complete statistics which should be available as an aid to the stimulation of intelligent competition within any trade group.

In the rubber industry there are certain basic statistics that practically all manufacturers are interested in maintaining and to which they can contribute, without the use of any extra clerical effort. In this category can be classed our reports on crude rubber imports and crude rubber consumption and stocks. This information enables manufacturers to keep informed regarding the supply and demand for their principal raw material as a guide for establishing their purchasing policies. The reports are distributed to members much earlier than similar information on imports, for example, can be made available by the Department of Commerce. Our report on crude rubber consumption is the only source of information of this kind on a monthly basis. They are reconciled annually with total consumption figures published by the Department of Commerce. We also compile and distribute basic statistics dealing with the net sales value in dollars for all major rubber product groups. This information can also be furnished quite readily by practically any company without excess effort.

As examples of the more intimate type of statistics requiring extra clerical effort and which are not distributed to other than participants, we have a so-called Monthly and Cumulative Detailed Tire and Tube Report which shows the unit production and stocks of tires and tubes by sizes, together with unit shipments classified as between sales for original equipment on automobiles, replacement and export sales. This report is a very interesting compilation for any manufacturer as a guide in production scheduling and furnishes industry style and size trends, which would not be readily available to any individual company without an extremely costly market survey. This report requires a considerable amount of clerical effort for each participant, and it is therefore essential that its distribution be restricted to participants only, for if any manufacturer could secure such a compilation without contributing his own figures, he could secure all the benefits of the report without incurring the expense of becoming a contributor.

Another confidential report which it is necessary to restrict to participants only is one showing the per cent of capacity operated for one branch of the industry, which is issued on a weekly basis. This report is based upon the machine hours operated in relation to available machine hours and is designed to show the average per cent of capacity that this branch of the business is operating which cannot be provided in any other way, inasmuch as the product is measured in yards of varying width, some single texture, others double texture, so that yards or value are not proper measurements of the activity of this group. Unless the distribution of such a report is restricted to participants, it would be extremely difficult to maintain a sufficient number of partic-

ipants to make the resulting figures worth the effort to compile them. The reports described are by no means a complete list of the statistical compilations made for the rubber industry, but merely serve as an example of the two general classes of statistics mentioned.

Most statistical compilations are of interest to the general public. Therefore, great pressure is frequently brought to bear on trade associations by economists, banks, brokers and promoters to secure reliable information of a detailed character. If this information were readily available to the general public, a majority of the smaller companies would not feel justified in incurring the expense of the necessary clerical effort for reporting their own information. For this reason, this type of information can be made more reliable and more complete by restricting its distribution to contributing members of the industry only, making it necessary for each company to submit a report before they can inspect the consolidated statement. This procedure sometimes appears rather high handed and arbitrary to non-contributors anxious to secure information which they know is available, but the writer believes that restricted distribution is justified in the interest of more complete statistics. After all most non-contributors are seeking this information for economic studies, or for personal promotion work of benefit solely to themselves.

Before statistics can be of any real value, their reliability must be established beyond any reasonable doubt. It is therefore of great importance that the central agency, to whom the reporting companies submit their most confidential information, establish faith in its integrity so that the individual reporting company will be assured that its data will not be revealed to anyone outside the confines of the central office. One of the steps that we take in the Rubber Manufacturers Association to accomplish this end is to return the original contributor's report with the completed figures, or in some cases, we keep the reports for a limited period of time for checking purposes and then destroy them so that we do not possess any individual company's figures which have been reported to us in the past. Our records consist solely of total industry figures. We believe that this faith in the central agency is the foundation of any reliable statistical compilation and insures the reporting of accurate facts.

In the collection of statistical information care must always be taken to define specifically what the contributor is expected to report. The mere request to report sales in dollars is utterly inadequate, for some companies may report gross sales, others net sales, according to their own interpretation of each term. It is essential that a very specific definition be given, itemizing any deductions that should be made

from gross sales if net sales are desired, for many companies within the same industry may have widely differing ideas as to the classification of expenses, some of which may be considered either as deductions from sales or as elements of cost, thereby destroying the comparability of the figures. As an illustration of such a definition of sales values, we quote below from our instructions to members when the sales value of domestically produced shipments is requested:

NET SALES VALUE OF SHIPMENTS

Represents net realized sales revenue from domestically produced rubber goods (including export) i. e., gross sales to customers less trade discounts, returns and all allowances, excise and sales taxes, transportation, provisions for adjustment losses, periodical volume rebates, price decline rebates, cash discount on sales, obsolete finished goods losses, allowances for factory shipments to customers and Royalties (Assessed on Sales Basis). Sales from company owned retail stores should be reported at wholesale value.

Another problem of vital importance in any industry in establishing the comparability of statistics from month to month is the varying number of participants. The industries which are able to maintain 100 per cent participation in their statistical reports over an extended period of time we believe are in the minority, as the management changes in the various companies from time to time, and with such changes come variations in company policy sometimes influenced by economic necessity, or through the personal idiosyncracies of the management. It is a constant ordeal for the statistical department in any trade association to continually solicit the non-contributors to participate, or renew participation after they have dropped out. In so many cases the potential contributor has not been fully informed of the existence of certain statistical compilations, or has not been made fully acquainted with the benefits that can be derived from such statistics. There does not appear to be any guaranteed panacea for maintaining regular participation—it simply requires unmitigated diligence on the part of those compiling the reports by following up delinquents and by educational measures to establish interest in the benefits of the service.

The tide of interest in statistics seems to rise and fall periodically, following generally, the business cycle. When business is good, the number of statistical compilations, considered desirable by an industry, seems to multiply until it becomes a voluminous mass of information requiring considerable clerical effort on the part of contributors, as well as in the central office. On the other hand, adverse business conditions call a halt to this expansion. When this happens, the pendulum usually swings in the opposite direction, according to our experience, making it necessary to exert every effort to maintain

and prove the value of the basic statistics for the industry in the general scrapping of apparently useless statistics during an economy wave.

Frequently, a delinquent participant renews participation in a report and submits figures for past periods which should be incorporated in the report to preserve its comparability and completeness. Since the report has been distributed without this single participant's figures, to send out corrected reports would mean that the identity of the additional participant and his figures would be disclosed which is not particularly desirable. In order to conceal the figures of such companies, but at the same time make our reports complete, we have followed the policy of never compiling amended reports for past periods, but merely incorporating the missing figures in cumulative statistical compilations, together with any corrections that have been brought to our attention since the original report was issued.

Unless statistics are issued with some degree of promptness, their value is lessened. It is therefore highly essential that steps be taken to insure the distribution of the report as soon as possible after the close of a period. The usual follow-up letters and telegrams, as reminders that reports are overdue, are not always successful in stirring delinquents to promptness. We have adopted a measure, that has met with some degree of success, of setting opposite the name of each participant the date its report was received in the Association office. Usually, our reports can be issued within a day after the receipt of the last participant's figures, so that these dates serve as a check on the efficiency of the Association Statistical Department and announce to the industry the delinquents who are responsible for the delay in issuing the report.

When an Association does not secure 100 per cent participation by all members of an industry, it is quite difficult to ascertain the degree of completeness of its reports in the industry. We have found it highly desirable to work closely with the Department of Commerce, giving every aid possible to insure accurate figures for the Biennial Census and any other special reports by which we can check the completeness of the Association figures. We have worked quite successfully along these lines for a number of years so that we are able to state on our reports the approximate percentage of completeness by which the figures can be raised to 100 per cent with some degree of accuracy.

It is our policy to make our statistical reports represent facts only, as reported by contributing members, unembellished in any way and without interpretation or predictions as to future trends. They are presented in a clear and precise manner, together with the percentage of completeness, where possible, so that each recipient can draw his own conclusions from the figures as presented.

CHANGES IN THE WHOLESALE PRICE INDEX IN RELATION TO FACTORY EMPLOYMENT*

By Irving Fisher
Yale University

THE CHAIN of causes most pertinent to the present study is:

(1) money-shortage, or scarcity of dollars in circulation tends to make the dollar dear, that is, tends to reduce the price level,

(2) reduction in the price level tends to reduce employer's profits (or to turn profits into losses), by reducing their receipts without a corresponding reduction in their expenses, these expenses being largely fixed by contract—especially bond interest, rent, salaries and even wages, and

(3) reductions in employers' profits and increases in their losses lead them to reduce employment and to shut down production, that is to reduce the volume of trade.

These effects of price-declines on trade and on employment do not, however, occur at once but after a lag; and the lag is not a fixed lag but a lag distributed over a long period of time. I have previously[1] described this method in detail and will only summarize it here. In the investigations, price-decline occurring in any month, such as June, was taken as half of the two months' decline from May (or the month preceding the given month) to July (the month succeeding the given month), this two months' price decline (May to July) being reckoned as a percentage of the price-level of the said given month (June). Thus each month has its own separate percentage price-decline—or price-advance, as the case may be.

My working hypothesis is that the effect of each such price-decline begins immediately, in a slight degree, and then rapidly increases up to a maximum after which it very gradually decreases, tapering off almost indefinitely. The total distribution forms one type of a frequency distribution curve, or curve of probability. The type is a skew type but nearly "normal" if the effect Y, or ordinate, is plotted with the *logarithm* of time as the X, or abscissa, the time being reckoned from the month whose price-decline is under consideration. That is, the probability curve is nearly normal in the "geometric" sense, not the arithmetic.

* Revision of a paper presented at the Ninty-seventh Annual Meeting of the American Statistica Association, New York City, December 30, 1935.

[1] "Our Unstable Dollar and the So-called Business Cycle," *Journal of the American Statistical Association*, June 1925.

In still other words, it was provisionally assumed that, if the price-decline in a given month has its maximum or modal effect in, say, eight months, then its effect felt in a month half as far away (four months) would be the same as its effect in twice as far away (sixteen months) and, in general, that equal effects occur on the two sides of the mode at distances such that the distance to the mode is a mean proportional between them, i.e., that on a *logarithmic* time scale they are equally distant from the mode.

I then sought to find (using the logarithmic time scale) the "best" time-lag to the mode and the "best" standard deviation from that mode; that is, I sought to find the probability curve which, when used as the basis of calculation, would result in a series of calculated employment figures nearest to the actual employment figures.

The calculated employment curve is found by two steps. The first step is to apply the above probability curve separately to each month's price-decline, that is to calculate what its theoretical effects, following the duly distributed lag, would be. The second step is simply to combine, or add together, the many separate probability curves just specified, one curve for each month.

If we denote the index number[2] of prices at any month by P, and the percentage price-rise (or price-decline) in that number by P', the total computed effect, in any month, of all the P''s of previous months is denoted by $\bar{P}'$. Thus $\bar{P}'$ may evidently be considered as an aggregate of the preceding P''s.

A simpler way of stating this is that $\bar{P}'$ is an hypothetical computation of what employment would be if its fluctuations were *wholly* due to the influence of previous price-rises or price-declines, the P''s producing their effects after the duly distributed lag.[3] It remains to compare this $\bar{P}'$, or *computed* employment, with the *actual* employment[4] (E).

It has been found that substantially the same results are obtained, and with far less labor, by using a short-cut. In this short-cut the lag instead of being distributed according to the above described skew probability curve, is assumed to be distributed according to a *straight line*, beginning at a maximum at one unit of time (month or quarter)

[2] The Wholesale Commodity Price Index of the Bureau of Labor Statistics was chosen for P, partly because its technique is best developed, and partly because changes of wholesale prices are most directly related to profits, which determine employment, or the employment (factory employment) of which we have statistics. It would be interesting to try other indexes such as Carl Snyder's General Price Index, or such as an index of "basic" commodities.

[3] For a fuller discussion of the method of establishing $\bar{P}'$ see: "Our Unstable Dollar and the So-Called Business Cycle," *Journal of the American Statistical Association*, June 1925. See also Max Sasuly, *Trend Analysis of Statistics* (*Theory and Technique*), Washington, D. C., The Brookings Institution, 1934, p. 201.

[4] The Federal Reserve Board Index of Factory Employment (Adjusted for Seasonal Variation) and revised according to the New Federal Reserve Board figures from 1927 to date, has been used for plotting E. E for October and November 1935 is Bureau of Labor Statistics figures linked to the September 1935 figure of the Federal Reserve Board seasonally adjusted index.

after the "cause" (P') and tapering off to zero after a specified number of months.

When this short-cut is used there is only one parameter of the effect, the total length of time to the vanishing point, instead of the two parameters in the longer method (namely the time from the given month to the mode and the deviation from that mode). By means of this short-cut, the labor of computation is greatly reduced.[5]

Some critics, unfamiliar with mathematical statistics, have argued that to adjust the parameter or parameters, so as to get the best fit, is making the fit to suit. This is answered in the 1925 article referred to. Suffice it here to say that, for such critics, a convincing answer is that, after finding the best fit for one period, if the very same formula, thus found best for that period, be then applied to any other period, it is found to give almost as good a result as if it had been based on the statistical data for this second period. In fact, to save labor I have, from time to time, brought the calculations down to date merely by using the law of lag found best for previous periods, although still better fits or correlations could have been obtained.

The results show that both trade[6] (T) and employment (E) have fluctuated as if they were under the influence of price-declines and price-advances, said influence being felt after a lag distributed according to a specified "law" of probability. The chart shows a general correspondence between $\bar{P}'$ and E.

The comparison between the real and the computed E (that is $\bar{P}'$) is thus simply the verification of the hypothesis that price-declines, after a lag, cause unemployment, that is, a reduction in E; while price-advances after a lag, cause employment, that is, an increase in E. This verification is I think, sufficient to establish the general correctness of the hypothesis. But the correspondence between the actual and the computed fluctuation in employment is naturally far from exact; since many other causes operate concurrently.

Among other influences is the *direct* influence of money-shortage on T irrespective of the intermediation of P, technological improvements, seasonal influences, mobilization for war, demobilization after war.

I would call attention to the most outstanding cases of failure in the verification.

These seem to be chiefly three, namely:

(1) The calendar year 1917 and the first half of 1918

(2) From the middle of 1931 to the middle of 1932

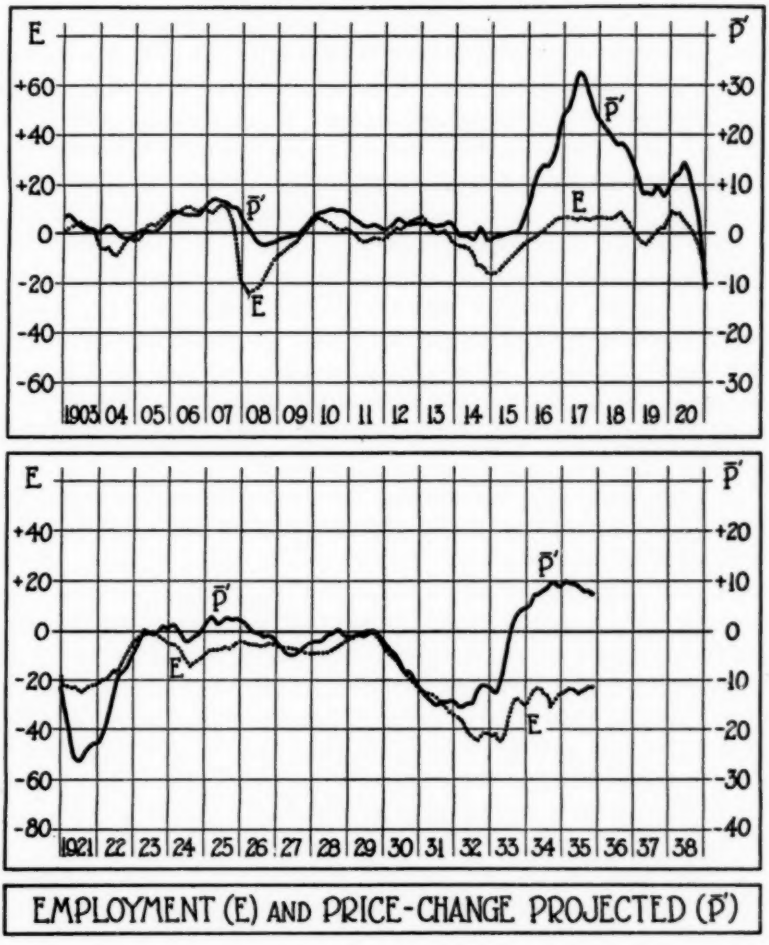
[5] For making the computation for this article and for several of my previous articles on this subject my thanks are due to Mr. Max Sasuly.

[6] For T, The Warren M. Persons' Index of Industrial Production and Trade, adjusted for seasonal variations and trend, has been used.

(3) From the middle of 1933 to date.

And all but the first of these three exceptions are also found when, in the comparison, E is replaced by T.

INDEX OF FACTORY EMPLOYMENT AND COMPUTED EFFECT OF PRICE CHANGES ON EMPLOYMENT, 1903-1935



EMPLOYMENT (E) AND PRICE-CHANGE PROJECTED ($\bar{P}'$)

Let us consider these three exceptions in order:

(1) The explanation of the fact that employment was flattened out in the United States in 1917 and part of 1918, while $\bar{P}'$ has a peak, is probably the military draft. The curve for the volume of Trade (T) during this period and afterward, behaves somewhat differently,[7] but perhaps as we might expect under the influence of war.

[7] See *Booms and Depressions* or almost any of the other writings mentioned in previous footnotes

(2) The period between the middle of 1931 and the middle of 1932 (fall of T and E but rise of $\bar{P}'$) seems the most difficult to explain of the three. This exception is found not only in the United States, but throughout the world.[8]

(3) The third exceptional period is limited so far as I know to the United States, and begins about August, 1933. This was when the policy of restriction of production under the N.R.A. and A.A.A. began to have its effects. These included trade and production restrictions and therefore employment restriction. In particular, the N.R.A. hindered employment by reducing hours but not reducing pay per day and so artificially raising wage rates per hour. The dole and relief work likewise interfered with the ordinary processes by which employment would naturally be determined.

Finally, the restrictions on production changed the significance of the price-declines and price-advances themselves. Probably the period since 1933 is the only period in the charts when changes in the price-level as embodied in $\bar{P}'$ are not altogether the expressions of monetary causes. The result is that, for this period since 1933, there is no observable relation between the calculated $\bar{P}'$ and the actual employment E.

The interesting fact here is that the period dominated by N.R.A. and A.A.A. was an exception to the rule just stated. A rise of the price level due to monetary causes increases profits and, therefore, increases production, trade and employment, but a rise in the price level due to restriction on production, trade, and employment or consisting simply of arbitrary mark-ups of prices and wages, need not increase, and may decrease profits and therefore decrease production, trade and employment. This may explain why the rise of prices when due to the present Administration's restrictive policies, did not help employment as shown in our curves since July 1933 and also why, after the abolition of N.R.A., the arrest in the rise of prices due to the arrest of the scarcity policy did not apparently hurt but rather helped employment.

It may, perhaps, be said that all three of the exceptional periods mainly represented some sort of interference by Government (plus, of course, the drought and dust storms). At any rate, under ordinary conditions, both trade and employment vary with $\bar{P}'$ that is, price-declines (or price-advances) after the proper lags.

The chart, herewith given, is only for employment (E) and extends only back to 1903. But in previous publications,[9] I have, as already

[8] For discussion, see "Are Booms and Depressions Transmitted Internationally by Monetary Standards?", *XXII Session (London, 1934) de L'Institut International de Statistique*, Section 2. Separate reprints.

[9] See "Our Unstable Dollar and the So-Called Business Cycle," *Journal of the American Statistical Association*, June 1925.

stated, shown similar results both as to trade T and E. These have been given by months (and compared with $\bar{P}'$) back to 1903, and by quarters back from 1903 to 1877.

Similar but rougher calculations as to the volume of business and $\bar{P}'$ have been made for 25 countries. As T and E usually run parallel, we are, I believe, safe in making the generalization, based on statistics for many years and for many countries, that employment varies with lagged price-change. This conclusion has been reached before. The present paper simply brings down to date, so far as possible, a series of my previous studies.[10]

Another investigator in this field is Henri Fuss. In an article, "Unemployment in 1925,"[11] after reviewing changes in employment and in the price level of many countries, he said: " . . . changes in the general price level have a very important influence on fluctuations in unemployment and employment." And the Report of the International Labour Office on "Unemployment and Monetary Fluctuations"[12] came to the following conclusions:

> . . . it seems to be possible to declare emphatically that abrupt, or even slow but prolonged, variations in the general price level, or in other words, disturbances in the equilibrium between production and the means of payment, play no small part in determining the alternating acceleration and retardation of economic activity, and are hence an important cause of the recurrent unemployment crises which mark one phase of the cycle.
>
> If, then, the magnitude of variations in the general price level could be reduced, an important cause of unemployment would be rendered less potent. . . .

The League of Nations World Economic Surveys during the past four years have contained valuable data on the subject of changes in prices, trade and employment. The last *Survey*,[13] in particular, calls attention

[10] "The Business Cycle Largely a 'Dance of the Dollar'," *Journal of the American Statistical Association*, December 1923, pp. 76–79.

"Fluctuation in Price Levels" in the *Problem of Business Forecasting*, Vol. 6 of the Pollak Publications, Pollak Foundation for Economic Research, Newton 58, Mass. Also Houghton-Mifflin and Co., June 1924.

"Our Unstable Dollar and the So-Called Business Cycle," *Journal of the American Statistical Association*, June 1925, pp. 179–202;

"Banking Policy and Unemployment," *American Labor Legislation Review*, March 1926, pp. 24–29;

"Statistical Relation between Unemployment and Price Changes," *International Labor Review*, June 1926;

"The Unstable Dollar as a Factor in the Credit Man's Problem," *Bulletin of the Robert Morris Associates*, July 1927;

Booms and Depressions, New York, Adelphi Company, 1932, xxi, 258 pp.

"The Relation of Employment to the Price Level," address given before the American Association for the Advancement of Science, Atlantic City, N. J. December 28, 1932 and later published in *Stabilization of Employment*, edited by Charles F. Roos, Principia Press, Inc., Bloomington, Ind., 1933, pp. 152–159;

"The Debt-Deflation Theory of Great Depressions," *XXI Session, (Mexico, 1933) de l'Institut International de Statistique*, Section 2. Also in *Econometrica*, October, 1933.

"Are Booms and Depressions Transmitted Internationally through Monetary Standards?" *XXII Session, (London, 1934) de l'Institut International de Statistique*, Section 2, Separate Reprints.

[11] Henri Fuss, "Unemployment in 1925," *International Labour Review*, 1926, pp. 228–230.

[12] "Unemployment and Monetary Fluctuations," report presented to the Twelfth Session of the International Labour Conference, May-June, 1929, in "Unemployment, Some International Aspects, 1920–28." *International Labour Office Studies and Reports*, Series, C.N. 13. Geneva, 1929.

[13] Series of League of Nations Publications, II. Economic and Financial, 1935. 11. A. 14. pp. 60–67

to the disruption of the price structure by the decline of commodity prices and its adverse effect on productions and trade, which involves also employment. According to this *Survey* a rise of wholesale prices, while expenditures remain constant, tends to restore the equilibrium between different price groups (such as wholesale and retail; consumers' and producers'; farm products and manufactured goods) and is most helpful in promoting recovery. This recovery is most pronounced in the countries with depreciated currencies.

Mr. Fuss had another article on this subject in 1927,[14] and so did Mr. Norman Lombard in 1928.[15] Warren and Pearson, in their book, *Prices*,[16] 1933 and in the revision in 1935, under the sub-title *Gold and Prices*,[17] give charts and statistics showing the same general results as those reached by previous writers. One of their charts gives a comparison between the wholesale price index and unemployment in England in 1888–1934 and another gives a comparison between the wholesale price index and employment in Massachusetts in 1889–1934. Reference is also made to Canada, Sweden, Denmark and Germany. Another careful student in the field of employment is Major J. R. Bellerby.[18]

So far as I know, all students of the subject agree that price-decline is a major, if not the major, cause of unemployment. This is probably true without reservation when the price-decline is due to shortage of money.

There is, therefore, no great novelty in the conclusions of the present paper. In fact, for generations, it has been common knowledge, or at any rate a common observation, that falling prices cause trade depression and unemployment and that rising prices stimulate trade and employment. But before the method of distributed lag was brought forward in 1925, these observations related only to price movements which were either very long or very great, or both. The method of distributed lag shows that the same influences can be traced, almost month by month through short and milder price movements and even through short alternations of rise and fall. Finally, the statistical method (of distributed lag) is stressed as of value not only in the field here studied but in every other field where a lag between two time series is under consideration.

[14] *International Labour Review*, November, 1927.
[15] "Stabilization of Employment and Central Bank Policies," *American Labor Legislation Review*, March 1928, pp. 87–89.
[16] *Prices*, 1933, and its revision, *Gold and Prices*, 1935, New York (Wiley) London (Chapman and Hall).
[17] Ibid.
[18] *Control of Credit as a Remedy for Unemployment*, P. S. King & Son, Ltd. 1923.

DISCUSSION

Fisher's discussion of "Changes in the Wholesale Price Index in Relation to Factory Employment" deals with an economic theory which he regards as hypothetical, as something to be tested empirically, and of which he therefore proceeds to make empirical tests. Such an attitude toward economic theory and such testing, it will be generally agreed among statisticians, is the type of procedure economists should follow, if economics is to be scientific.

Fisher finds the verification which results from his tests "sufficient to establish the general correctness of the hypothesis" that "price-declines, after a lag, cause unemployment, that is, a reduction in E; while price-advances, after a lag, cause employment, that is, an increase in E." Yet many will feel that the evidence above presented for the relationship between prices and employment in this country is not adequate to this conclusion. While economic statisticians agree that economic hypotheses such as Fisher's should be tested statistically, they are not in entire agreement as to what constitutes a satisfactory statistical test.

There are offered here for consideration some proposed standards for statistical validation of hypotheses which have not been met in Fisher's paper.

1. Specifications regarding data, methods, and concepts should be adequate. Adequacy will here be defined only negatively and by enumeration.

The type of changes in prices and employment under consideration is not clearly stated. It is presumably "cyclical" in that Fisher's E curve is corrected for seasonal variation and apparently for trend at least from 1903 to 1920.

We are not told what the factory employment curve represents prior to 1919, and more especially prior to 1913. The method of seasonal adjustment prior to 1919 is not specified. The method of trend correction is not specified. No reference to a previously published statement of these points is made.

With respect to the derived wholesale price curve, Fisher does not specify either here or in his earlier article on the method of distributed lags[1] precisely how many successive monthly increments of the wholesale price index are used to compute a monthly ordinate of his $\bar{P}'$ curve, or how this ordinate is computed from them.

2. In addition to a clear specification of what data are used there is need for comment on the significance of their known characteristics for the problem in hand, and need for careful limitation of the conclusions in the light of these characteristics. Fisher offers no discussion of the comparability of the two indexes for his purposes. The conclusions are not always clearly limited to factory employment. No mention is made of the varying reliability of the indexes in different periods.

3. To establish a causal relation between one type of cyclical variation,

[1] *Journal of the American Statistical Association*, June, 1925.

P, and another type, E, it should be shown that P precedes E in a sense in which E does not precede P. Fisher does not do this. His evidence for a lag involves two steps: (1) His derived price curve $\bar{P}'$ is made up by lagging a function of several successive monthly increments in the wholesale price index after these monthly increments. This gives his distributed lag effect for the derived price curve $\bar{P}'$ behind the curve of price increments P'. (2) The derived price curve is then examined visually for agreement on a synchronous basis with the factory employment curve. Thus, E is shown to lag behind the curve of monthly increments in the price index, not to lag behind the price index curve itself. It may conceivably be true at the same time that P lags analogously behind the curve of monthly increments in factory employment. When two time series, A and B, can be represented by synchronous sine curves, the curve of monthly increments in each will lead the other curve. But one would not be justified in noting that the curve of monthly increments in A leads the B curve and then concluding, as Fisher does, that changes in A cause changes in B.

With respect to Fisher's lag technique, we may note first that the operations involved in computing the derived price curve have the effect of producing a curve which bears a somewhat definite relation to the original price index curve. $\bar{P}'$ differs from P in that both major trend features and sporadic month-to-month variations are missing. Yet the remaining movements are recognizably similar and appear to synchronize in P and $\bar{P}'$, although the relative amplitudes of these (chiefly cyclical) fluctuations in P and the dates of the maxima and minima are not always maintained in the derived price curve. Fisher offers no evidence that $\bar{P}'$ lags behind P, and hence no evidence either that E (which appears synchronous with $\bar{P}'$) lags behind P, or that changes in factory employment lag behind changes in the wholesale price level.

We may note second that while the derived price curve, except for minor sporadic variations and major trend features, bears a readily recognizable resemblance to the original price index curve some of the relative amplitudes of the cyclical fluctuations in the two curves differ markedly. Thus in $\bar{P}'$ the 1917 level is above that of 1919; the magnitude of the 1920–1 drop is about twice that of the 1929–31 drop; the post–1929 drop ends in mid-1931 instead of early 1933; and the level of 1934–5 is above the 1929 level. It will be recalled that Fisher finds difficulties in comparing $\bar{P}'$ with E in 1917–8, 1931–2, and 1933–5.

4. The argument from *post hoc* to *propter hoc* is precarious at best; it calls for special care when applied to cyclical variations. Many series move up and down with the ups and downs of business. Assuming that Fisher had established that cyclical movements in the wholesale price index precede those in the factory employment index (although a synchronous relationship is more nearly consonant with his evidence), would this show anything except that prices respond more quickly than employment to a common influence?

Fisher's hypothesis involves an intermediate causal link on which few monthly data are available; the sequence is (a) price change, (b) profit change, (c) employment change (and change in physical volume of business). If a (selling) price increase is to increase profits and so increase employment, the price increase and the employment increase should be evident in the same industry. Because the wholesale price index and the factory employment index differ considerably in weights and selection of items, the positive correlation between commodity price movements and changes in factory employment should, according to Fisher's hypothesis and barring the type of exceptional case he considers in 1917–8 etc., be improved if we examine this relationship industry by industry. But if it should appear that some industries account largely for the cyclical fluctuations of the price series and other industries account largely for the fluctuations of factory employment, such a finding might suggest that when industries are responding to a common pressure of improving or declining prosperity, some respond more readily in price changes, others more readily in physical volume changes.[2]

To recapitulate, it is suggested (1) that fuller specifications of data, methods, and concepts should have been provided; (2) that greater care should have been exercised to delimit the conclusion in the light of what is known about the factual evidence employed; (3) that while a lag is established, no statistical analysis is offered that shows this lag more nearly consistent with a causal influence of P on E than with a causal influence in the converse direction; (4) that the validity of the argument from *post hoc* to *propter hoc* might in this case have been either partly confirmed or else definitely disproved by examining the relationship between P and E industry by industry.

MORRIS A. COPELAND

Central Statistical Board

REJOINDER

Professor Copeland infers that I must have intended to restrict the correspondence between $\bar{P}'$ and E to cyclical movements, because the seasonal and trend movements had (for E) been eliminated.

It is true that when I had a choice of indices for E, I chose the series from which seasonality and trend had been eliminated. But I made no special point of such elimination nor, in any case, did I myself calculate them. Through all my various studies on lagged-price-change in relation to employment, trade, and other variables I have used whatever figures I found available, ready made for me by others. In many cases there had been no such eliminations.

Moreover it would be very rash to assume that after such eliminations the resultant series is cyclical or even near-cyclical. As is well recognized,

[2] Cf. Gardiner C. Means, this JOURNAL, vol. 30, June, 1935, esp. p. 405.

these residual movements at least contain non-cyclical ingredients. Furthermore the cyclical ingredients are, or may be, so numerous and conflicting[1] that their resultant is probably never definitely cyclical in any period of time so short as included in this study. For these reasons I would distrust any seeming cyclical movements.

Professor Copeland suspects that such cycles exist, with corresponding cycles in P. But he gives no evidence of this nor of any rationale for some common cause.

I agree, of course, that it would be interesting to reverse the lag calculations and to see whether P, or P', or $\bar{P}'$ may not be found to follow E as well as to precede E. I hope Professor Copeland will make such a study, if he thinks it worth while. Meanwhile we may at least say that the results so far conform to my working hypothesis, and that this hypothesis is a rational one. Even most of the few exceptions found have plausible explanations. The only important exception which still puzzles me is for the year 1931–2.

Moreover, even if it should some day be found that reverse causal relationships exist, this would not, as Professor Copeland seems to think, disprove the existence of the direct causal relationships of which I have shown evidence. On the contrary, in any study of booms and depressions we must always deal with vicious circles. We may joke over whether the egg precedes the chicken or the chicken the egg, but we know that both are true and that both are true causally.

It would be still more interesting, as Professor Copeland suggests, to study the price-employment problem with relation to different industries. I much hope this may be done.

As to the "fuller specifications of data, methods and concepts," I am sorry if any essential specifications have been omitted; for it has always been my practice to make it possible, through specifications or references given, for any readers who so desire to repeat the work. In previous articles specifications are given at greater length and where specifications are brief or omitted, references are given to sources. It would have been a great waste of space to describe how other authors derived their data,—for instance, how Dr. Persons eliminated from E the trend and seasonality.

It should be remembered that, in all these studies, the only contribution of my own has been the calculation of $\bar{P}'$ from P. The methods used were described fully in my previous articles cited, especially "Our Unstable Dollar and the So-called Business Cycle."

IRVING FISHER

[1] See my "Business Cycles as Facts and Tendencies," *Overdruk uit Economische Opstellen*, Aangeboden aan Prof. Dr. C. A. Verrijn Stuart, Haarlem, de Erven F. Bohn N.V., 1931.

FACTORIAL AND CORRELATIONAL ANALYSIS OF THE 1934 VOTE IN CHICAGO

By Harold F. Gosnell and Margaret J. Schmidt
University of Chicago

In the present study a comparison is made between the multiple factor methods and partial correlation techniques in analyzing data regarding voting behavior in the city of Chicago. The city was divided into 147 units into which election and census material could be conveniently fitted. For experimental purposes, it was decided to include seventeen variables, four of which were taken from successive election returns. The election variables were calculated by finding the percentage of the total vote received in each area by the Democratic candidate. Since the votes received by minor party candidates were so small, they were neglected. Consequently, the Republican percentage could be calculated in any given area by subtracting the Democratic percentage from 100. The other variables were selected carefully on the ground that they had some specific contribution to make to the understanding of the political variables. Lack of space does not permit the full consideration of the reasons for selecting each of the variables and of the limitations of each for the purposes in hand.[1] All of the variables are expressed in percentage form except median rental and Table I gives certain characteristics of their distributions.

The votes selected for Table I are satisfactory for some purposes but they do not reveal clearly the steady trend toward the Democratic Party since 1927. The peak of Democratic popularity appears to have been reached in the election of a United States senator in 1930. However, the vote which James Hamilton Lewis received as the Democratic candidate for this office does not represent the true strength of his party at this election. He ran far ahead of his ticket because his opponent, Mrs. Ruth Hanna McCormick, the first woman to receive a major party nomination for the office, had incurred the enmity of a prominent faction of the Republican party and had received unfavorable publicity in connection with the Senate investigation of campaign funds. Mrs. McCormick's slight of well-known Republican leaders, her expenditure of half a million dollars to win the nomination, and the fact that she was a woman, made her a weak candidate. In order to

[1] Some of the variables are discussed in H. F. Gosnell and N. N. Gill, "Analysis of the 1932 Presidential Vote in Chicago," *American Political Science Review*, XXIX (December, 1935), pp. 967–984 and in H. F. Gosnell and M. J. Schmidt, "Relation of the Press to Voting in Chicago," *Journalism Quarterly*, XIII (June, 1936), pp. 129–47.

TABLE I

VARIABLES USED IN STUDY OF 1934 CONGRESSIONAL VOTE IN CHICAGO
($N = 147$)

Variable	Letter Symbol	Date	Per cent for City*	Mean	Lowest Item	Highest Item	Standard Deviation
Smith Vote	a	1928	49.2	51.7	23.5	88.1	15.0
Lewis Vote	b	1930	72.1	76.0	42.9	91.5	8.6
Roosevelt Vote	c	1932	59.2	63.4	29.6	90.0	13.1
Igoe Vote	n	1934	64.0	66.4	34.4	92.2	12.5
Women Voters	d	1930	41.8	40.4	8.5	52.5	6.8
Party Vote	e	1932	58.4	58.4	28.1	87.3	12.0
Bond Issue	f	1930	58.0	56.6	43.8	85.6	7.7
Wet Vote	g	1930	78.6	78.4	59.7	93.3	5.7
Voting Interest	h	1930	66.3	66.8	34.2	104.1	11.0
Foreign Birth	i	1930	26.9	31.2	13.2	67.3	10.9
Catholic Origins	j	1930	32.4	34.1	4.2	84.6	21.0
Median Rental	k	1930	$49.56	$47.50	$15.22	$129.40	$18.50
Home Ownership	l	1930	31.1	35.8	.7	82.5	19.1
Unemployment	m	1931	22.7	28.3	3.7	69.4	12.5
Mobility	s	1934	27.6	25.0	11.5	49.0	6.9
Doubling-up	t	1934	8.0	6.9	1.8	14.5	2.2
Education	u	1934	26.1	24.8	5.5	66.7	15.6

* All figures are expressed in terms of percentages except median rental which is given in dollars. For variables a, b, c, and n, the totals used to calculate the percentages were the sums of the Democratic and Republican votes in each of the 147 areas. The other variables were calculated in the following fashion. Variable d is the percentage who were women of the total number of registered voters in October, 1930. Variable e is the percentage that the straight party votes were of the total votes cast in November, 1932. Variable f is the percentage "yes" votes cast for a 1930 bond issue. Variable g is the percentage "yes" votes cast on the 1930 public policy referendum calling for the repeal of the Eighteenth Amendment. Variable h is the percentage of the adult citizens that registered in October, 1930. Variable i is the percentage of adult citizens who were born in foreign countries. Variable j is the percentage of the total population born, or whose parents were born in the following countries which are regarded as Catholic countries: Irish Free State, Poland, Czechoslovakia, Austria, Hungary, Jugoslavia, Lithuania, Italy and French speaking parts of Canada. Variable l is the percentage of the total families that own their homes. Variable m is the percentage unemployed in 1921 of the gainful workers ten years of age and over. Variable s is the percentage of the total families that had lived less than one year at present address. Variable t is the percentage of total families with one or more subheads. Variable u is the percentage of the population, 18 years of age and over, which had completed more than ten grades in school.

Election returns were obtained from the *Chicago Daily News Almanac and Year Book*, the *Public Service Leader* and the records of the Board of Election Commissioners of Chicago. Census data were taken from E. W. Burgess and C. Newcomb (Eds.), *Census Data of the City of Chicago, 1930* (Chicago, 1933) and C. A. Newcomb and R. O. Lang, *Census Data of Chicago, 1934*, (Chicago, 1934).

The sections in which the population was 20 per cent or more Negro were excluded because these districts were atypical and destroyed the tendency which most of the distributions showed toward normality. Since the methods employed in this study assume normal distributions, it was regarded as desirable to consider the white voters only. One of the authors has written at length regarding the voting behavior of Negroes in Chicago. See H. F. Gosnell, *Negro Politicians: The Rise of Negro Politics in Chicago* (Chicago, 1935), pp. 15–92.

get comparable figures for the 1934 vote for congressman-at-large, the election returns for the same office are substituted for the Smith, Lewis, and Roosevelt votes in Table II.

James Hamilton Lewis, Democratic candidate for the United States Senator in 1930, ran much better than his fellow candidates, as comparison of his vote with that received by the Democratic candidates for congressman-at-large indicates. A comparison of Table II with Table I also shows that the percentage for Igoe is almost the same as the average percentage Democratic. Since the Igoe vote was much easier to calculate,[2] it was used as a measure of the Democratic strength in each of the 147 units employed.

[2] The percentage that Michael L. Igoe, Democratic candidate for congressman at large, received of the sum of his vote and the vote for C. Wayland Brooks, leading Republican candidate for the same office.

TABLE II

CONGRESSIONAL ELECTIONS IN CHICAGO, 1928–1934

Year	Total Average Vote Cast for Congressman-at-large*	Total Average Vote For Democratic Candidates	Per Cent Democratic
1928	1,173,425	532,036	45.4
1930	827,751	490,954	59.3
1932	1,269,698	725,456	57.1
1934	1,099,974	712,612	64.8

* Two congressmen are elected at large from Illinois. The city of Chicago has about one half of the voters in Illinois. The average was found by adding the votes for all Democratic and Republican candidates and dividing by two.

It is difficult to handle as many as seventeen variables by the ordinary statistical techniques. Some statisticians say that for partial regression equations not more than four or five variables should be used. From the logical standpoint it is clear that it is foolish to express the Smith vote as a function of the Igoe vote, on account of the time element. Consequently, the Igoe vote furnishes the only proper starting point. Can the Igoe vote be explained in terms of the Roosevelt vote? Columns *c* and *n* of Table III show the relationships of these two variables to the fifteen remaining variables in the 147 units. Product moment coefficients of correlation for the ungrouped data were calculated in each case.[3]

While the Igoe vote was on the average 3 per cent higher than the Roosevelt vote in the various sections of the city, the coefficients show that there was a close relationship between votes for the two candidates. In fact, the Igoe vote was most highly associated with the Roosevelt vote as the coefficient of $.960 \pm .01$ indicates. Considering the fact that in some of the areas many people had moved in the two-year period following the 1932 election, this coefficient is remarkably high. In other words, party tradition and party organization appeared to account for most of the variations in the Igoe vote. Where Roosevelt had been strong, Igoe was also strong and vice versa. However, there were some minor shifts in the Democratic support. Most of these can be accounted for on the theory that in 1932 the Republican support

[3] With $n = 147$, P.E.$_r$ for the values of r in Table III ranges from .083 when $r = .01$ to .008 when $r = .96$. When r is .56 it is ten times its *P.E.* When $r = .36$ it is five times its *P.E.* The t values for the significance of an observed correlation [R. A. Fisher, *Statistical Methods for Research Workers*, (London, 1932), pp. 171 ff.] range from .0963 when $r = .01$ to 41.285 when $r = .960$. Some of the intermediate values are given below:

r	t	r	t
.204	2.509	.565	8.245
.272	3.403	.636	9.924
.361	4.661	.785	15.259
.464	6.307		

It is apparent that with such large values for t beginning with a coefficient as low as .204 that sampling problems are not serious in this study. It should further be kept in mind that from the historical point of view, we have made a complete study of a limited universe. Sampling becomes important when one draws inferences from the Chicago data that might apply to other American metropolitan communities.

came largely from the Protestant, employed, well-educated, native born, relatively prosperous groups that tended to be drier than other groups and which had a larger proportion of women registered as voters. The Democratic gains of 1934 were made among people who had been formerly Republican. Consequently, the relation between the Igoe vote and political, social, and economic variables should logically be slightly less close than the relationship between the Roosevelt vote and these variables. This was the case for every variable except the following: party voting, women, bond issue, and mobility. The differences between the coefficients in columns *c* (Roosevelt vote) and column *n* (Igoe vote) involving variables *d*, *e*, *f* and *s* are zero or very small, but if an explanation is wanted, it would emphasize the fact that all of these variables were closely related to the measure of party voting. Since the Democrats had more patronage in 1934 than in 1932, we might expect the Igoe vote to be more highly correlated with organizational influences than the Roosevelt vote. A relatively large difference was found between the coefficients involving the wet vote and the Igoe and Roosevelt votes. This may be due to the fact that the repeal of prohibition had become a dead issue. As in the case of the Roosevelt vote, the Igoe vote has no apparent relationship to the variables doubling up and home ownership.

The fact that the variations of the Igoe vote as between the different areas so nearly paralleled the variations of many other measures raises a number of questions. If some of the variables are closely related to each other, does not this mean that they are measuring the same thing? In order to get as full a picture as possible with the data at hand, it is necessary to find the intercorrelations of all of the variables. This involves the calculation of 136 coefficients, each of which is presented twice in Table III, a symmetrical table called a *correlation matrix*. The repetition of the coefficients is necessary in order to facilitate the calculation of the multiple factor loadings to be described later.

A detailed comparison could be made between the intercorrelations of the Igoe vote and those of each of the other variables. However, such a procedure would leave a confused impression. The correlation matrix may be presented in a much simpler form by going through certain transformations devised by Professor L. L. Thurstone under the name of *multiple factor analysis*.[4] It is not feasible within the limits of this paper to discuss the theory and mathematics of this method. One purpose of multiple factor analysis is to determine how many general and independent factors it is necessary to postulate in order

[4] For a description of the methods of multiple factor analysis see *The Vectors of Mind, Multiple-Factor Analysis for the Isolation of Primary Traits* (University of Chicago Press, 1935).

TABLE III

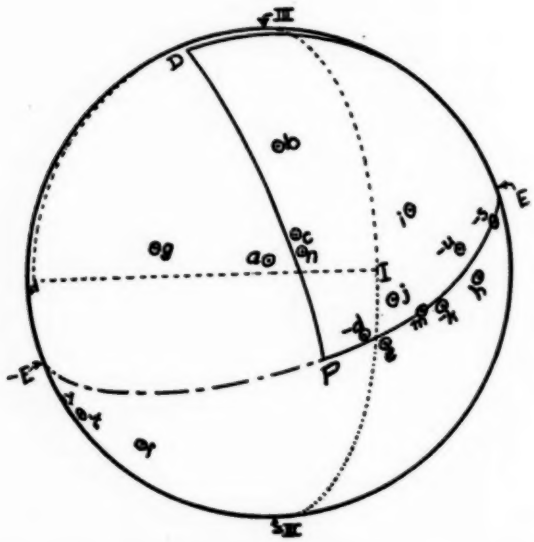
CORRELATION MATRIX

INTERCORRELATIONS OF SEVENTEEN VARIABLES RELATED TO VOTING BEHAVIOR IN CHICAGO, 1930–1934

	Letter Symbol	Smith *a*	Lewis *b*	Roosevelt *c*	Igoe *n*	Women *d*	Party Voting *e*	Bond Issue *f*	Wet Vote *g*	Voting Interest *h*	Foreign Birth *i*	Catholic Origins *j*	Median Rental *k*	Home Owners *l*	Unemployment *m*	Mobility *s*	Doubling Up *t*	Education *u*
Smith	*a*		.78	.94	.91	−.57	.79	.47	.64	.35	.64	.78	−.62	−.15	.69	−.32	−.18	−.62
Lewis	*b*	.78		.84	.81	−.55	.62	.17	.62	.21	60	.57	−.53	.03	.57	−.33	−.10	−.63
Roosevelt	*c*	.94	.84		.96	−.66	.84	.40	.62	.27	.73	.78	−.68	−.05	.76	−.35	−.11	−.73
Igoe	*n*	.91	.81	.96		−.66	.85	.44	.57	.27	.71	.76	−.64	−.05	.72	−.37	−.06	−.70
Women	*d*	−.57	−.55	−.66	−.66		−.68	−.37	−.34	−.21	−.51	−.54	.58	−.07	−.68	.42	.14	.65
Party Voting	*e*	.79	.62	.84	.85	−.68		.45	.42	.48	.66	.75	−.76	.08	.81	−.51	−.01	−.81
Bond Issue	*f*	.47	.17	.40	.44	−.37	.45		.50	.08	.14	.20	−.12	−.57	.25	.20	−.02	−.05
Wet Vote	*g*	.64	.62	.62	.57	−.34	.42	.50		.10	.38	.34	−.34	−.33	.36	.00	−.22	−.30
Voting Interest	*h*	.35	.21	.27	.27	−.21	.48	.08	.10		.32	.32	−.43	.18	.32	−.49	.16	−.44
Foreign Birth	*i*	.64	.60	.73	.71	−.51	.66	.14	.38	.32		.72	−.66	.16	.71	−.48	.14	−.74
Catholic Origins	*j*	.78	.57	.78	.76	−.54	.75	.20	.34	.32	.72		−.74	.15	.78	−.53	−.17	−.73
Median Rental	*k*	−.62	−.53	−.68	−.64	.58	−.76	−.12	−.34	−.43	−.66	−.74		−.25	−.80	.62	.01	.88
Home Owners	*l*	−.15	.03	−.05	−.05	−.07	.08	−.57	−.33	.18	.16	.15	−.25		.25	−.72	.40	−.36
Unemployment	*m*	.69	.57	.76	.72	−.68	.81	.25	.36	.32	.71	.78	−.80	.25		−.58	.01	−.84
Mobility	*s*	−.32	−.33	−.35	−.37	.42	−.51	.20	.00	−.49	−.48	−.53	.62	−.72	−.58		−.19	.68
Doubling Up	*t*	−.18	−.10	−.11	−.06	.14	−.01	−.02	−.22	.16	.14	−.17	.01	.40	.01	−.19		−.14
Education	*u*	−.62	−.63	−.73	−.70	.65	−.81	−.05	−.30	−.44	−.74	−.73	.88	−.36	−.84	.68	−.14	

to account for a correlation matrix.[5] The application of the centroid method to the data at hand brought out the fact that the 272 intercorrelations could be expressed in terms of three general factors. Further computations to see if there was a fourth factor indicated that three were sufficient. A three factor solution means that it is possible to regard the three loadings for each variable as coordinates locating that variable as a point with reference to a given sphere. The points inside the sphere were projected to the surface (normalized) and the

CHART I



resulting pattern was studied so as to determine where the three planes of reference should pass. Chart I gives an idea as to the nature of the graphic solution of the problem at hand. The relation of this geometrical figure to the correlation matrix may readily be traced by estimating the angular separation between any two points. Where the angular separation is small, the degree of correlation is high between the normalized variables concerned. An angular separation of 90 degrees shows an absence of relationship or zero correlation between normalized variables, while one of more than 90 degrees shows a negative correlation. (A minus sign on the chart means that the variable has been reflected to the opposite end of the diameter of the sphere through the point.) Chart I shows that variables *-d*, *e*, *j*, *m*, *-k*, *h*, *-u*, *-s*, *l*, *t*, and *f*

[5] The word factor is used in the following technical sense: factors are reference variables in terms of which given variables can be expressed as linear functions. The factor loadings are the coefficients or weights given to the reference variables in the linear function for a particular variable.

tend to fall near a plane which might be passed through the center of the sphere, and through *m*, and *s*. It is also clear the variables *a*, *n*, *c*, and *b* are near a plane that could be passed at right angles to the first plane and through the centroid of *a*, *n*, *c*. Where the third plane of reference should be cannot be determined without adopting an arbitrary rule. There are no points which indicate a logical solution. For

TABLE IV

VOTING BEHAVIOR IN CHICAGO: 1930–34
COORDINATES INSIDE SPHERE[++]
MATRIX *FL* (FACTOR LOADINGS)

		P Traditional Democratic Machine Vote in Poor Foreign-born Areas*	*E* Home Owners and Opposition to Bond Issue+	*D* Special Influences Favoring Democratic Candidates Including the Wet Vote**	Communality
	Letter Symbol *x*	r_{xA_p}	r_{xA_e}	r_{xA_d}	h^2_{III}
Smith	*a*	.919	−.094	.282	.9329
Lewis	*b*	.669	.094	.623	.8445
Roosevelt	*c*	.898	.043	.411	.9772
Igoe	*n*	.880	.052	.375	.9177
Women	*d*	−.719	−.163	−.060	.5471
Party Voting	*e*	.911	.238	−.053	.8894
Bond Issue	*f*	.493	−.453	−.100	.4582
Wet Vote	*g*	.595	−.323	.388	.6089
Voting Interest	*h*	.356	.341	−.066	.2474
Foreign Birth	*i*	.642	.391	.264	.6347
Catholic Origins	*j*	.810	.274	.046	.7333
Median Rental	*k*	−.752	−.468	.018	.7848
Home Ownership	*l*	−.166	.846	.124	.7586
Unemployment	*m*	.807	.412	.000	.8210
Mobility	*s*	−.371	−.812	.000	.7970
Doubling Up	*t*	−.177	.381	.088	.1842
Education	*u*	−.712	−.617	−.108	.8993
Actual Σ		5.083	.142	2.232	12.0362
Check Σ		5.083	.141	2.232	12.0364

* Distance of variable *x* from *DE* plane.
\+ Distance of variable *x* from *PD* plane.
** Distance of variable *x* from *PE* plane.
\++ Calculated from centroid co-ordinates inside sphere.

purposes of convenience it was decided to make the third plane orthogonal to the other two. This enables an easy transformation from the coordinates to the original coefficients.[6] Using the three planes described above the loadings given in Table IV were obtained for the seventeen variables.

The next step is to name the factors. Mathematically, the solution

[6] Since the factor loadings are derived from the correlation coefficients, it is possible to calculate the correlation between any two variables by employing only the factor loadings. The process of transformation is given by the following equation

$$r = a_{11}a_{21} + a_{12}a_{22} + a_{13}a_{23}$$

where a_{11} is the loading of variable *a* in factor I, a_{12} is the loading of variable *a* in factor II, a_{13} is the loading of variable *a* in factor III, and a_{21}, a_{22}, a_{23} represent respectively the loadings of variable *b* in factors I, II, and III. Taking an actual example from Table IV, we find that the correlation of the Igoe vote with the Roosevelt vote calculated from thef actor loadings is .95 and that the original coefficient is .96.

may be quite satisfactory but its meaning may not be clear. The method does not insure that the factor loadings will be such that they can be readily labelled. The magnitude of the loadings, the signs, and the geometric solution must all be considered when arriving at names for the factors.

The most stable of the planes is the *PE* plane because it has the greatest number of points which are close to it. The distance of any given variable from this plane determines the loading which that variable has in Factor *D*. The highest loadings are Lewis vote (.623), Roosevelt vote (.411), wet vote (.388), Igoe vote (.375), and Smith vote (.282). It is clear that this factor is a highly political one; it represents the extent to which the five variables mentioned have peculiar qualities that distinguish them from the social and economic variables. However, since the loadings are low it means that the political variables were separated from the social and economic variables only to a limited extent. The most independent of all is the Lewis vote and this coincides with the logic of the situation which has already been discussed. There were peculiar influences at work to accentuate the size of the Lewis vote. The other elections also had distinctive political characteristics which marked them off from the other variables. We may therefore name this factor "Special Influences Favoring Democratic Candidates Including the Wet Vote."

Next to the *PE* plane the *PD* plane is the most stable since it has at least four points which are fairly close to it. Distances from this plane, or loadings in Factor *E* as they are called, are given in column two of Table IV. Disregarding signs, the nine highest loadings in the order of their magnitude are home ownership (.846), mobility (−.812), education (−.617), bond issue (−.453), median rental (−.468), unemployment (.412), doubling up (.381), foreign birth (.391), interest in voting (.341). These loadings mean that variations in the proportion of home owners had no definite linear relation to variations in party preferences. In Chicago, home owners are highly tax conscious whether their homes are palatial or extremely modest. While it is hard to combine these descriptions, we may say that Factor *E* represents "Home Owners (many of whom are in poor communities) and Their Opposition to Bond Issues."

Paradoxical as it may seem the factor which has the highest loadings in the solution under discussion is the one which is the least stable. The plane *DE* has few points which are very close to it. Home ownership (*l*) is the nearest and doubling up (*t*) comes next, but it cannot be said that these are sufficient to determine the location of the plane. Chart I shows that there is no point which is close to pole *D* which

marks the intersection of the planes *DE* and *PD*. On the other hand it is obvious that the loadings of the variables in Factor *P* have considerable significance. They show the high degree of relationship between the political variables and the social and economic variables. In the order of their magnitude without regard to signs the highest loadings are: Smith vote (.919), party voting (.911), Roosevelt vote (.898), Igoe vote (.880), religious affiliation (.810), unemployment (.807), median rental (−.752), women (−.719), education (−.712), Lewis vote (.669), foreign birth (.642), wet vote (.595), and bond issue (.493). This factor is obviously the traditional Democratic machine vote which is concentrated in the poor areas where there are many Catholics of foreign extraction and relatively few women voters. We may call this factor the "Traditional Democratic Machine Vote in the Poor Foreign Born Neighborhoods."

According to the multiple factor solution, the Igoe vote more closely resembles the Roosevelt vote than either the Smith vote or the Lewis vote. The slight changes which took place between 1932 and 1934 in the various voting areas of Chicago tended to move the Democratic vote closer to party voting and to the inverse of the ratio of women registered. Since the Igoe vote has a slightly lower loading in Factor *D* than the Roosevelt vote, it can be said that there were fewer special political influences at work in the congressional election. In other words, most of the variations of the Igoe vote can be expressed in terms of Factor *P*, which represents the traditional Democratic machine vote. This factor gives the most general picture of the configuration presented in this study.

An entirely different set of assumptions is involved if it is desired to predict the Igoe vote from the other variables. According to the regression equation technique, the Igoe vote should be expressed as a function of the other variables. This assumes that the independent variables are perfect measures of something or other.[7] While our data do not justify this assumption, the method is nevertheless useful. A logical starting point is the Roosevelt vote since it is so highly correlated with the dependent variable. The regression equation for the Igoe vote as a function of the Roosevelt vote is as follows: $X_n = 10.592 + .87905\ X_c$. The main thing that this equation shows is that on the average Igoe got a high percentage of the Roosevelt vote plus a diminishing number of other voters as the Roosevelt vote increased. Where the Roosevelt vote was relatively low, the average gains made by Igoe over the Roosevelt vote were greatest and where the Roosevelt

[7] The solution of partial regression equations by means of determinants brings out this assumption clearly. The figure 1 is used for all diagonal entries. The factorial method uses the highest coefficient in the column for the diagonal entry.

vote was high, Igoe's average gains were least. In fact, in the areas where the Roosevelt vote equalled or excelled 88 per cent one might expect to find an Igoe vote which was equal to or less than the Roosevelt vote. Actually, the scatter diagram shows that there were no such cases. The points which are not close to the regression line indicate some of the influences which account for the 1934 shifts in the Democratic vote. In certain Republican areas which were relatively dry in 1932 there were marked shifts to the Democratic side two years later. Other areas which were strongly Democratic in 1932 did not show any increases in Democratic strength two years later.

Would the addition of other variables to the equation materially increase the closeness of the fit to the Igoe vote? In order to answer this question, the following variables were selected, X_g, the wet vote, X_i per cent foreign born, and X_k median rental.[8] An examination of Chart I will show that these variables are not highly intercorrelated with each other. The equation of regression which describes the relationship between the Igoe vote as a dependent variable and the others as independent variables as follows: $X_n = 14.34614 + .91644X_c - .10765X_g + .03080X_i + .02847X_k$. The standard error of estimate for this equation ($S_{n.cgik} = 3.30386$) is not much lower than that for the equation $X_n = (f)X_c$, ($S_{n.c} = 3.66740$). The equation of net regression may be interpreted as meaning that the average change in the Igoe vote for a unit change in the Roosevelt vote, keeping the other variables constant, was very high, whereas the average change in the Igoe vote for unit changes in each of the other variables, keeping the Roosevelt vote and the remaining variables constant, was relatively insignificant.[9] It is interesting to note that the sign of the net regression coefficient for X_g is negative whereas the sign of r_{ng} is positive. This reversal of signs means that keeping the Roosevelt vote, foreign birth and median rental constant the net relationship between the Igoe vote and the wet vote was low and inverse.[10] As we have already seen, Igoe won votes among dry Republicans and he did not run quite as well as expected in certain wet Democratic areas.

Since the Igoe vote and the Roosevelt vote are so closely related, the question may be raised as to how the Igoe vote may be explained with-

[8] The regression equations for X_n on these variables are:

$$X_n = -23.204 + 1.1422\,X_g; \quad S_{n.g} = 9.907$$
$$X_n = 42.055 + .7783\,X_i; \quad S_{n.i} = 8.461$$
$$X_n = 86.020 - .4141\,X_k; \quad S_{n.k} = 9.273$$

[9] The third order coefficients of partial correlation give the same general results. They are: $r_{nc.gik} = .888$; $r_{ng.cik} = -.141$; $r_{ni.cgk} = .066$; $r_{nk.cgi} = .109$. The coefficient of multiple correlation is only slightly higher than r_{nc}($R_{n.cgik} = .96156$).

[10] The standard errors for the coefficients of partial regression indicate that except for the parameter of X_c we cannot tell whether the signs are positive or negative. The standard errors are: $b_{nc.gik} = .91644 \pm .040$; $b_{ng.cik} = -.10765 \pm .063$; $b_{ni.cgk} = .03080 \pm .039$; $b_{nk.cgi} = .02847 \pm .022$. These standard errors show clearly the overwhelming importance of X_c in the equation.

out reference to party tradition as measured by previous voting behavior.[11] In other words, what sort of people have acquired the habit of voting Democratic in Chicago? Leaving out the Roosevelt vote, the following equation of net regression was obtained: $X_n = 6.1028 + .6799X_g + .4675X_i - .1610X_k$. This equation indicates that the average change in the Igoe vote for a unit change in the wet vote, keeping the other variables constant, was fairly high. The coefficient of net regression for the percentage of foreign-born was lower but significant. On the other hand, economic status as measured by median rental did not add greatly to the accuracy of the estimated Igoe vote when the other variables were held constant.[12] The standard error of estimate for the equation is $S_{n.gik} = 7.1825$ which is much higher than that for the regression of X_n on X_c, and not much lower than that for the regression of X_n on X_i. It is interesting to note that signs for the coefficients of net regression in this equation are the same as those for the original zero order coefficients.[13] This means that when the Roosevelt vote is eliminated we cannot perceive the slight shift of voters in relatively dry areas to Igoe.

We are now in a position to consider the relative advantages and disadvantages of the multiple factor and the correlation techniques. The multiple factor method permits the handling of a large number of variables without a great deal of labor. In a preliminary analys s of a given problem it may be very desirable to retain as many variables as possible. If the number of factors obtained is less than four, then it is possible to make a model of the factorial matrix in highly simplified geometric form. Once the meaning of the transformation is understood it is possible to grasp the relationships of the variables very readily. It may happen that the factorial solution will reveal new and significant categories. On the other hand, factor analysis makes it impossible to consider one variable as a dependent variable.[14] In the present problem, the Igoe vote is the only one of the election variables which can be logically considered as a dependent variable. In the fac-

[11] Using variable g and four others the following equation of net regression was obtained for the Roosevelt vote: $X_c = 2.6925 + .5428X_a + .2242X_e + .2002X_g + .0253X_j + .1063X_m$. $S_{c.aegjm} = 3.874$. It is clear that the net regression coefficient for the Smith vote was the highest. How can we explain the Smith vote? There is no end to this process.

[12] The second order coefficients of partial correlation reverse the order or relative importance of the wet vote and the foreign-born.

$r_{ng.ik} = +.442$ $r_{ni.gk} = +.467$ $r_{nk.gi} = -.297$

[13] The standard errors for the coefficients of partial regression are: $b_{ng.ik} = .6799 \pm .116$; $b_{ni.gk} = .4675 \pm .074$; $b_{nk.gi} = -.1610 \pm .043$. $R_{n.gik} = .8022$. The t values for the differences between these coefficients of regression (Fisher, *op. cit.*, pp.150 ff.) show that they are all significant except the difference $b_{ng.ik} - b_{ni.gk}$ where $t = 1.4102$.

[14] The dependent variables are the primary tendencies of the individual group of voters which are to be estimated in terms of the variables given. In other words, the primary factors are the dependent variables. See Thurstone, *op. cit.*, p. 54.

torial analysis it is treated as an independent variable like all of the rest. The factorial method does not guarantee a meaningful solution. It may be impossible to give clear cut definitions to the factors and the solution itself may be indeterminate.

Factorial methods raise another problem. At the present time, the probable errors have not been worked out for factor loadings calculated according to Thurstone's methods. The factors are essentially linear functions of the variates which have certain statistical properties. Since they are obtained from quantities which in themselves are subject to fluctuations, it is contended by some that the first problem is to find sampling distributions and adequate methods for testing the significance of the results obtained. The problem is a very ticklish one. We do not think that the objection should prevent an experimental use of the factorial method. In the present problem where $n = 147$ and where each of the 147 areas has on the average a population of 10,000 citizens, we were rash enough to see whether the method would yield some categories of significance in political science even before methods were devised to calculate sampling errors. The methods of net regression require the selection of a dependent variable and they permit a more exact analysis of the net relationships with their probable errors.

Both of the methods employed in the present study show that party tradition as measured by previous voting behavior was the most important influence in the 1934 election in Chicago. The method of partial correlation in particular minimizes other influences. The main characteristics of party lines in Chicago, a typical American metropolitan community, were set long before the depression and the New Deal.[15]

[15] The present study has been mainly concerned with the congressional elections of 1934. However the materials also throw light on a number of other topics. In an article which appears elsewhere, one of the authors made the tentative conclusion based on part of the data which appears in this article, that interest in voting as measured by the per cent of adult citizens registered tends to vary inversely with economic status. "Analysis of the 1932 Presidential Vote in Chicago," *Op. cit.* This conclusion was contrary to what he discovered in an earlier study which employed different methods. See H. F. Gosnell *Getting Out the Vote* (Chicago, 1927), p. 117. The addition of the variable mobility reconciles the two studies. It is not that the poor are more interested in voting but the middle income groups living in apartment areas are more transient. A high mobility means that many of the adult citizens do not fulfill residence qualifications for voting, that they are unfamiliar with the location of polling places and that they are more likely to escape the attention of the party workers.

PRINCIPAL COMPONENTS*

By M. A. Girshick
Columbia University

THE PROBLEM of analyzing a set of statistical variables into a set of independent variates (i.e. components), which are in a sense to be more fundamental in character, is as much a statistical problem as a mathematical one. The quantities to be analyzed are by their very nature subject to fluctuations and consequently to sampling errors. The same holds true for any function of such quantities. It follows that any solution of this problem, if it is to be of any value, must not only be consistent with certain facts and assumptions in the science of psychology, but must also lend itself to statistical treatment. The truth of the above becomes more evident when it is realized that from the stand point of pure mathematics, the problem lends itself to an infinite number of solutions.

Essentially, there are two questions to which answers must be provided, whatever the method of factoring into components, if that method is to have any meaning. (1) Is the sample of persons that took the test sufficiently large to warrant the statement that more than any specific number $p(<n)$ components are required to account for the battery of n tests? (2) Will these components remain stable from one battery of tests to another taken at random? The answer to the first question involves a sampling theory of errors pertaining to a population of *persons*. The second involves a sampling theory of errors pertaining to a population of *tests*.

Professor Hotelling in his paper "Analysis of a Complex of Statistical Variables into Principal Components"[1] has approached the problem of components from essentially this point of view. Not only has he given in this paper a method of obtaining the components, but he has also made substantial contributions to the two types of sampling theories mentioned above.

Professor L. L. Thurstone,[2] in his latest contribution to the theory of components, has been aware of the errors of measurement involved in the problem, but he has not availed himself of the modern theories of sampling distributions and tests of significance developed in recent years by theoretical statisticians under the influence of R. A. Fisher.

* Research under a grant-in-aid from the Carnegie Corporation of New York.
[1] *The Journal of Educational Psychology*, September and October, 1933.
[2] *The Vectors of Mind*, The University of Chicago Press, 1935.

For this reason, the usefulness of the methods he proposes will depend to a great extent on the possibility of constructing sampling theories for testing the results obtained by his methods. In this respect, his centroid method seems to be the most promising. The factor loadings of the first component obtained by the centroid method are continuous functions of the correlations. They can be interpreted as either first approximations to Professor Hotelling's factor loadings (this can be seen by applying the iterative process only once with the initial trial values all equal to unity, and then dividing by $1/\sqrt{\sum_i \sum_j r_{ij}}$, or as correlations between each variable and the sum of the variables if the variables are reduced to standard measure. The factor loadings of the other components do not lend themselves to simple interpretations. In fact, the methods of reflection by arbitrarily changing signs in the correlation matrix makes them non-analytic functions of the correlations. This undoubtedly will create difficulties in constructing sampling theories. But it is not at all unlikely that this difficulty will be overcome.

Professor Thurstone criticizes Hotelling's method mainly on two grounds: (1) He objects to the fact that Hotelling uses 1's in the main diagonal of the matrix of correlations instead of communalities. (2) He claims that Hotelling's solution is an artifact because of the assumption that there are as many components as there are tests.

In answer to the first objection, it should be pointed out that Professor Hotelling's contribution to the theory of components does not in the least depend on using 1's in the main diagonal. They are used as a convention and not as an essential part of the theory.

As to the second objection, we shall show in this paper that Hotelling's results can be obtained without making use of the assumption that there are as many components as observed variates. The present derivation is not only independent of this assumption but it is also shorter and requires less knowledge of the theory of equations.

We shall also, in this paper, get the principal components as by-products of the solution to the following two problems: (1) Given a set of variates, to find a linear function of the variates which has least variance ascribable to errors of measurement. (2) To find a linear function of these variates such that the sum of the squares of the correlation between the function and each variate shall be a maximum. The first approach will exhibit a property of the principal components which is of statistical importance, viz., that if all tests have equal reliability coefficients, and therefore equal variances of errors of measurement, then *the first principal component is that linear function of the*

variates which has least variance resulting from errors of measurement, and among all linear functions of our variates which are uncorrelated with the first component, the second component has least variance resulting from such errors, and so on for the other components. The second approach will emphasize the fact (pointed out by Professor Hotelling) *that of all linear functions of the variates, the first principal component has the greatest mean-square correlation with the tests*; the second component the next greatest mean-square correlation, etc.

In the last part of this paper we shall prove that the factor loadings of the principal components are *maximum likelihood statistics.*[3] This fact seems to show that if a set of variates are to be analyzed into components, Hotelling's Principal Axes method is the most efficient one to use; "efficient" having here the technical meaning as defined by R. A. Fisher.

Throughout this paper we shall use the convention that a repeated subscript in the same term stands for summation unless otherwise stated. For instance, instead of writing $\sum_{j=1}^{n} a_{ij}x_j$, we shall simply write $a_{ij}x_j$. The range of the repeated subscript will be clear from the context.

I

Let $z_1, z_2, \cdots, z_n$ be n statistical variables which have been reduced to "standard measure." The problem is to find a set of uncorrelated variables: $\gamma_1, \gamma_2, \cdots, \gamma_p$, $(p \leqq n)$ each of unit variance, such that

$$z_i = a_{ij}\gamma_j \quad (i = 1, 2, \cdots, n; \quad j = 1, 2, \cdots, p). \tag{1}$$

The following equations follow immediately from (1):

$$Ez_iz_k = r_{ik} = a_{ij}a_{kj} \tag{2}$$

$$Ez_i^2 = \sigma^2_{z_i} = a^2_{i1} + a^2_{i2} + \cdots + a^2_{ip}, \tag{3}$$

where E denotes the mathematical expectation or mean value of the expression following.

Let $S = a_{i1}a_{i1}$. S is the sum of the contributions of γ_1 to the variance of all z's. We shall maximize S subject to condition (2).

Let $$2T = S - \lambda_{ik}a_{ij}a_{kj}$$

where $\lambda_{ik}(=\lambda_{ki})$ are Lagrange multipliers. Then

$$\frac{\partial T}{\partial a_{i1}} = a_{i1} - \lambda_{ik}a_{k1} = 0 \tag{4}$$

[3] A similar proof, but from a different standpoint, was first given by William G. Madow of Columbia University.

$$\frac{\partial T}{\partial a_{ij}} = -\lambda_{ik}a_{kj} = 0 \quad (j \neq 1). \tag{5}$$

We combine (4) and (5) into one equation:

$$\frac{\partial T}{\partial a_{ij}} = \delta_{1j}a_{i1} - \lambda_{ik}a_{kj} = 0 \tag{6}$$

where the symbol δ_{ij} has the value zero for $i \neq j$ and 1 for $i = j$.

Multiplying (6) by a_{i1}, summing with respect to i, and setting $\sum_i a^2_{i1} = k_1$ we get

$$\delta_{1j}k_1 - \lambda_{ik}a_{i1}a_{kj} = 0 .$$

Since $\lambda_{ik} = \lambda_{ki}$, we use equation (4) to replace $\lambda_{ik}a_{i1}$ by a_{k1}. We thus get

$$a_{k1}a_{kj} = \delta_{1j}k_1 . \tag{7}$$

If we multiply (7) by a_{mj}, sum with respect to j, and use (2), the result is:

$$r_{km}a_{k1} - k_1a_{m1} = 0 . \tag{8}$$

The rest of the argument is identical with that of Professor Hotelling[4] and need not be repeated here.

To solve for the γ's in terms of the z's it is not necessary to employ Cramer's rule (which method necessarily assumes that there are as many γ's as there are z's), for we can use the following device: Multiply (1) by a_{im} and sum with respect to i. This yields

$$a_{im}z_i = a_{im}a_{ij}\gamma_j . \tag{9}$$

Since by (7) $a_{im}a_{ij} = k_m\delta_{jm}$ (not summed for m), equation (9) becomes

$$a_{im}z_i = k_m\gamma_m \qquad \text{(not summed for } m\text{)},$$

or

$$\gamma_m = a_{im}z_i/k_m . \tag{10}$$

II

Let $z_1, z_2, \cdots z_n$ be as above. We shall assume that each test score z_i is made up of two parts, a true score ξ_i and a random error ϵ_i where the ϵ_i are uncorrelated with each other and with ξ_i and are of zero mean. We shall further assume that the variance of the ϵ's is the same for all the tests.

Let γ be any linear function of the z's and let σ'^2 be that part of the variance of γ which results from the errors of measurement. Then, if γ is given in the form

[4] *Loc. cit.*

$$\gamma = \alpha_i z_i \tag{2.1}$$

it can easily be shown that

$$\sigma'^2 = \sigma^2 \sum_i \alpha_i^2 \tag{2.2}$$

where σ^2 is the variance of the random errors.

We now require γ to be that linear function of the z's which is of unit variance and for which σ'^2 is a minimum. In order to find such a γ we have to minimize the following quantity:

$$\sigma^2 \sum_i \alpha_i^2 - \mu \sum_i \sum_j \alpha_i \alpha_j r_{ij}$$

where

$$\sum_i \sum_j \alpha_i \alpha_j r_{ij} = E\gamma^2 = 1 , \tag{2.3}$$

and μ is a Lagrange multiplier. The minimizing conditions are

$$\sigma^2 \alpha_i - \mu \alpha_j r_{ij} = 0 \quad (i = 1, 2, \cdots, n) . \tag{2.4}$$

Let

$$\mu = \sigma^2/\lambda \tag{2.5}$$

then (2.4) becomes

$$\alpha_j r_{ij} - \lambda \alpha_i = 0 . \tag{2.6}$$

For this set of homogeneous linear equations to have a non-trivial solution, it is necessary and sufficient that

$$\begin{vmatrix} 1-\lambda & r_{12} & r_{13} \cdots & r_{1n} \\ r_{21} & 1-\lambda & r_{23} \cdots & r_{2n} \\ \cdot & \cdot & \cdots & \cdot \\ r_{n1} & \cdot & \cdots & 1-\lambda \end{vmatrix} = 0 . \tag{2.7}$$

Substituting a simple root of (2.7) into the equations (2.6) we get a family of solutions all of which are proportional to one solution. If we multiply (2.6) by α_i, sum with respect to i, and use (2.3), we get

$$1 - \lambda \sum_i \alpha_i^2 = 0 . \tag{2.8}$$

This determines the factor of proportionality.

When (2.4) is multiplied by α_i and the result summed with respect to i, the result is

$$\sigma'^2 = \mu = \sigma^2/\lambda .$$

This shows that a large λ corresponds to a small σ'^2. It follows therefore that for the solution of our problem we must choose the *largest* root of (2.7). This completes the proof as far as our original problem is concerned.

It is obvious that every distinct root of (2.7) defines a set of α's and hence a γ. We thus get a whole set of γ's which can be expressed as

$$\gamma_i = \alpha_{ij} z_j .$$

We shall now show that these γ's are precisely the principal components derived in Part I, *and thus prove the statement that the first principal component (defined by the largest root of (2.7)) is that linear function of the variates which has least variance ascribable to errors of measurement.*

First we prove that the correlation between any two distinct γ's is zero. Obviously

$$E\gamma_i\gamma_j = \alpha_{ip}\alpha_{jl} E z_p z_l = \alpha_{ip}\alpha_{jl} r_{pl} .$$

Now, by (2.6)

$$\alpha_{ip} r_{pl} = \lambda_i \alpha_{il}; \quad \alpha_{jp} r_{pl} = \lambda_j \alpha_{jp} \quad \text{(not summed for } i \text{ or } j\text{)}.$$

Hence

$$E\gamma_i\gamma_j = \lambda_i(\alpha_{jl}\alpha_{il}) = \lambda_j(\alpha_{jp}\alpha_{ip}) .$$

When $\lambda_i \neq \lambda_j$, the above equation can hold only if

$$\alpha_{il}\alpha_{jl} (= \alpha_{ip}\alpha_{jp}) = 0 . \tag{2.9}$$

Hence

$$E\gamma_i\gamma_j = 0 . \tag{2.10}$$

Equations (2.8) and (2.9) can be combined into the equation

$$\lambda_i \alpha_{il}\alpha_{jl} = \delta_{ij} \quad \text{(not summed for } i\text{)} \tag{2.11}$$

and equations (2.10) and (2.3) can be combined into

$$E\gamma_i\gamma_j = \delta_{ij} .$$

If p of the roots of (2.7) are equal, the α's will not be uniquely determined. However, we can still find p linearly independent solutions of (2.6) which will satisfy the condition $\lambda_i d_{il} d_{jl} = \delta_{ij}$ where the p λ_i are all equal.

If we assume that the determinant $|r_{ij}|$ is not zero, the determinant of the α's, $|\alpha_{ij}|$, will also be different from zero. Let α^{ij} be the cofactor of α_{ij} in $|\alpha_{ij}|$ divided by $|\alpha_{ij}|$. Now $\gamma_i = \alpha_{ij} z_j$, therefore

$$\alpha^{ik}\gamma_i = \alpha_{ij}\alpha^{ik}z_j = \delta_{jk}z_j = z_k\,. \tag{2.13}$$

If we multiply (2.11) by α^{ik} and sum with respect to j, we get

$$\lambda_i\alpha^{ik}\alpha_{jl}\alpha_{il} = \alpha^{ik}\delta_{ij}\,,$$

or

$$\lambda_i\alpha_{ik} = \alpha^{ik}\,. \tag{2.14}$$

Substituting this in (2.13) we finally get

$$z_k = \lambda_i\alpha_{ik}\gamma_i\,. \tag{2.15}$$

Set $a_{ki} = \lambda_i\alpha_{ik}$ $(= E\gamma_i z_k)$ (not summed for i)

then

$$z_k = a_{ki}\gamma_i\,. \tag{2.16}$$

The quantities a_{ki} satisfy the following equation:

$$a_{jp}a_{jq} = \lambda_p\lambda_q\alpha_{pj}\alpha_{qj} = \lambda_p\delta_{pq}\,.$$

This follows from the definition and (2.11).

It is obvious that the a's are identical with those obtained in Part I. The γ's are therefore the principal components.

To get the α's and the λ's of Part II we can use the iterative method given by Professor Hotelling.[5] But instead of multiplying the final trial values, $a_1 \cdots a_n$, by $\sqrt{\lambda/\sum_i a_i^2}$ we multiply them by $1/\sqrt{\lambda\sum_i a_i^2}$. In other words we get the α's or the a's depending on whether we multiply the final trial values by $1/\sqrt{\lambda\sum_i a_i^2}$ or by $\sqrt{\lambda/\sum_i a_i^2}$.

III

Let $z_1, z_2 \cdots z_n$ be as above. We are going to solve the problem of finding a linear function of the z's such that the sum of the squares of the correlations between each z and the function shall be a maximum. For simplicity of calculation, we shall further require that the variance of the function be unity. Let γ be such a function:

$$\gamma = \alpha_i z_i \tag{3.1}$$

$$E\gamma^2 = \alpha_i\alpha_j Ez_iz_j = \alpha_i\alpha_j r_{ij} = 1 \tag{3.2}$$

$$E\gamma z_j = \alpha_i Ez_iz_j = \alpha_i r_{ij} \tag{3.3}$$

Loc. cit. A method for accelerating the iterative process by a matrix squaring technique is described by H. Hotelling in a paper shortly to appear in *Psychometrika*. Another method of obtaining the Principal Components can be found in T. L. Kelley's *Essential Traits of Mental Life*, Harvard University Press, 1935.

We want to maximize $\sum_j (\alpha_i r_{ij})^2$ subject to condition (3.2).

Let

$$2T = \sum_j (\alpha_i r_{ij})^2 - \lambda \alpha_i \alpha_j r_{ij}$$

where λ is a Lagrange multiplier. Taking the partial derivative of T with respect to α_i and setting the result equal to zero,

$$\frac{\partial T}{\partial \alpha_i} = \alpha_k r_{kj} r_{ij} - \lambda \alpha_k r_{ik} = 0 \tag{3.4}$$

we get a system of homogeneous linear equations in the α's. In order that these equations have a non-trivial solution, it is necessary and sufficient that the determinant of the equations, $|r_{kj}r_{ij} - \lambda r_{ik}|$, be equal to zero. If the determinant of the correlations, $|r_{ij}|$, is zero, the above determinant will be zero identically for all values of λ. This follows from the fact that

$$| r_{kj}r_{ij} - \lambda r_{ik} | = | r_{ij} | \cdot | r_{ij} - \lambda \delta_{ij} |. \tag{3.5}$$

In this case the α's of (3.4) are not uniquely defined and consequently the problem has no solution. We shall assume therefore that $|r_{ij}| \neq 0$. We multiply (3.4) by r^{il}, where r^{il} is the cofactor of r_{il} in the determinant $|r_{il}|$ divided by $|r_{il}|$, and sum with respect to l. This yields

$$\alpha_k r_{kj} \delta_{jl} - \lambda \alpha_k \delta_{kl} = 0$$

or

$$\alpha_k r_{kl} - \lambda \alpha_l = 0. \tag{3.6}$$

The α's can now be determined from these equations, and as above, the solution will be non-trivial if and only if

$$| r_{ij} - \lambda \delta_{ij} | = 0. \tag{3.7}$$

Substituting a simple root of (3.7) into the equations (3.6) we get a family of solutions all of which are proportional to one solution. If we multiply (3.6) by α_l and sum with respect to l, we get

$$1 - \lambda \sum_l \alpha_l^2 = 0. \tag{3.8}$$

This determines the factor of proportionality.

When (3.4) is multiplied by α_i and the result summed with respect to i, we get

$$\sum_j (\alpha_k r_{kj})^2 = \lambda.$$

This shows that the quantity we want to maximize is equal to one of the roots of (3.7). Hence for the solution of our problem, we choose the largest root of (3.7).

The rest of the argument is identical with that of Part II.

In deriving the components by the second and third methods, we had to assume that $|r_{ij}| \neq 0$. A similar situation would arise if we attempted to solve for the z's in Part I from equation 10. While it is possible in Part I to solve for the γ's in terms of the z's without this assumption, it is impossible to reverse the process. This apparent inconsistency is explained by the fact that in the first case we have more equations than unknowns but they happened to be consistent, in the second case we have more unknowns than equations and the solution cannot therefore be unique.

IV

Let $x_1, x_2, \cdots, x_s$ be a set of variates having a multivariate normal distribution. We wish to find a linear function of these x's such that the sum of the squares of the correlations between each x and the function shall be a maximum. It is obvious that the solution of this problem for the *population* will parallel step by step the one obtained in Part III for a *sample*. We will thus get for the population a set of linear functions $\gamma_1, \gamma_2, \cdots, \gamma_s$ such that

$$\gamma_i = \alpha_{ij} x_j \tag{4.1}$$

$$E\gamma_i\gamma_j = \delta_{ij} \tag{4.2}$$

$$\alpha_{ip}\sigma_{pq} - \lambda_i\alpha_{iq} = 0 \quad \text{(not summed for } i\text{)} \tag{4.3}$$

$$\lambda_i\alpha_{ip} = \alpha^{ip} \quad \text{(not summed for } i\text{)} \tag{4.4}$$

where $\sigma_{pq} = Ex_px_q$ and $\alpha^{ip} = (\text{cofactor of } \alpha_{ip})/|\alpha_{ip}|$.

It is easy to show that the distribution of the γ's will be given in the form:

$$\frac{1}{(2\pi)^{\frac{1}{2}s}} \exp\left(-\frac{1}{2}\sum_{i=1}^{s}\gamma_i^2\right) d\gamma_1 \cdots d\gamma_s .$$

If we perform the linear transformation (4.1) on the γ's, we get the distribution of the x's in the form:

$$\frac{|\alpha_{ij}|}{(2\pi)^{\frac{1}{2}s}} \exp\left(-\tfrac{1}{2}\alpha_{ip}\alpha_{iq}x_px_q\right) dx_1 \cdots dx_s .$$

Let $s_{ij} = S(x_{ia}x_{ja})/n$, where S stands for summation over the sample. The distribution density for the sample is then given by

$$\frac{|\alpha_{ij}|^{n}}{(2\pi)^{\frac{1}{2}ns}} \exp\left(-\tfrac{1}{2}n\alpha_{ip}\alpha_{iq}s_{pq}\right).$$

We shall now estimate the α's by the method of maximum likelihood. We take the partial derivative of

$$n \log |\alpha_{ij}| - \tfrac{1}{2}n\alpha_{ip}\alpha_{iq}s_{pq}$$

with respect to α_{ip} and set the result equal to zero. This yields

$$\alpha^{ip} - \alpha_{iq}s_{pq} = 0.$$

But by (4.4) $\alpha^{ip}=\lambda_i\alpha_{ip}$. Hence, the maximum likelihood estimates of the α's is given by the equations

$$\alpha_{iq}s_{pq} - \lambda_i\alpha_{ip} = 0.$$

This equation is the same as (3.6) with s_{pq} substituted for r_{pq}. Hence we have shown *that the α's and therefore the* a*'s are maximum likelihood statistics.*

THE NEGRO AS A FACTOR IN THE NATION'S LABOR FORCE

By Alba M. Edwards
Bureau of the Census

For many decades large numbers of Negroes have engaged in gainful occupations in the United States. They have helped produce its wealth, and they have had an important part in its social and economic life. What proportion of the Negroes are gainfully occupied? How important a factor are they in the nation's labor force today? How are they distributed over the occupational field, and what is their social-economic status? What has the future in store for the Negro workers? As the years pass, will a larger or a smaller proportion of them engage in gainful labor, and will they become a more or a less important factor in the labor force of the nation? What changes will take place in their occupational and their industrial distribution, and what changes in their social-economic status? If, with the further mechanization of industry, the machine takes over much of the unskilled work they are now doing, will they be able to rise to higher pursuits, or will they replace white workers in the remaining unskilled pursuits, or, finally, will they largely fall into that permanently unemployed class certain writers have prophesied that we shall have in the future? These questions are of vital importance, not only to Negro workers and the Negro race but also to workers in general, to employers and to society at large. They merit careful study by the statistician, the sociologist, and the public welfare specialist.

In 1930, 5,503,535 Negroes—3,662,893 males and 1,840,642 females—10 years old and over were engaged in gainful occupations, and they comprised 59.2 per cent of the Negro population 10 years old and over. The proportion of the population 10 years old and over gainfully occupied in 1930 was higher for Negroes (59.2 per cent) than for either native whites (47.0 per cent) or foreign-born whites (56.1 per cent). This fact is accounted for largely by the relatively large proportion of Negro females 10 years old and over gainfully occupied—38.9 per cent, as compared with 20.5 per cent of the native white females and with 18.8 per cent of the foreign-born white females. The proportion of males 10 years old and over gainfully occupied in 1930 was 80.2 per cent for Negroes as compared with 73.4 per cent for native whites, and with 88.4 per cent for foreign-born whites.[1]

[1] 1930 Census, *General Report on Occupations*, p. 74. The term "gainfully occupied," as used in

The proportion of single women 15 years old and over gainfully occupied in 1930 was not much higher for Negroes (52.1 per cent) than for native whites (48.7 per cent) and was not nearly as high for Negroes as for foreign-born whites (73.8 per cent). The proportion of married women and also the proportion of widowed and divorced women 15 years old and over gainfully occupied in 1930, however, was far higher for Negroes than for any other population class. Thus, 33.2 per cent of the married Negro women were gainfully occupied, as compared with only 9.8 per cent of the married native white women and with only 8.5 per cent of the married foreign-born white women; and 65.0 per cent of the widowed and divorced Negro women were gainfully occupied, as against 31.9 per cent of the widowed and divorced native white women and 21.1 per cent of the widowed and divorced foreign-born white women. In the broad age period 25 to 44 years, 35.9 per cent of the Negro married women and 81.6 per cent of the Negro widowed and divorced women were gainfully occupied in 1930.[2]

The foregoing statistics show that the married and the widowed and divorced Negro women are gainfully employed much more nearly up to the employable limit than are the white women of these classes, and hence, that there is less room for increase in the proportion of the Negro married and widowed and divorced women than in the proportion of the white married and widowed and divorced women engaged in gainful occupations.

How important a factor are Negroes in the nation's labor force? In 1930, Negroes formed 11.3 per cent of all gainful workers—9.6 per cent of all male workers and 17.1 per cent of all female workers. The relative importance of Negroes in the Nation's labor force appears to have been decreasing gradually, however, since they formed 14.3 per cent of all workers in 1890, 13.7 per cent in 1900, 13.6 per cent in 1910, and 11.6 per cent in 1920.[3]

Occupational classes. Two main classes of occupations—agricultural pursuits and domestic and personal service pursuits—have always furnished employment to a very large proportion of the Negro gainful workers. In 1930 not far from two-thirds (64.8 per cent) of the 5,503,535 Negroes engaged in gainful occupations were in these occupations —36.1 per cent in agricultural pursuits, and 28.6 per cent in domestic

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census occupation statistics, includes all persons who *usually* work at a gainful occupation, even though not at work at the time of the enumeration; and a "gainful occupation," in census usage, is an occupation by which the person who pursues it earns money or a money equivalent or assists in the production of marketable goods. The term "gainful worker" does not include women doing housework in their own homes, without wages, and having no other employment, nor children working at home, merely on general housework, on chores, or at odd times on other work.

[2] *Ibid.*, p. 274.

[3] *Ibid.*, pp. 74, 75; 1900 Census, *Report on Occupations*, p. lxxxii.

and personal service pursuits. Next in importance were manufacturing and mechanical pursuits with 18.6 per cent of the Negro workers. Transportation and communication pursuits gave employment to 7.2 per cent of the Negro workers, pursuits in trade to 3.3 per cent, and professional service to 2.5 per cent. The remaining Negro workers, comprising only 3.6 per cent of the total, were distributed among the other main classes of occupations—forestry and fishing (0.6 per cent), extraction of minerals (1.4 per cent), public service, not elsewhere classified (0.9 per cent), and clerical occupations (0.7 per cent).[4]

Social-economic groups. The position occupied by Negroes in the nation's labor force, and also their social-economic status, can be shown best by grouping the Negro gainful workers into a few large social-economic groups, such as professional persons; proprietors, managers, and officials; clerks and kindred workers; skilled workers; semiskilled workers; and unskilled workers. Such a grouping largely cuts across industry lines and brings together into one large group all of the workers belonging to the same social-economic class, without particular reference to the different occupations the workers may be pursuing. In Table I, the occupations of the Negro gainful workers of the United States have been classified into social-economic groups for each of the three census years, 1910, 1920, and 1930.[5]

Professional persons—group 1—formed only a very small proportion (2.1 per cent) of all Negro workers in 1930. While proprietors, managers, and officials—group 2—constituted 16.9 per cent of the total, most of those in this group were either farm owners or farm tenants. Clerks and kindred workers, the so-called "white-collar workers"—group 3—formed only 1.5 per cent of the total. These workers comprise office assistants, sales people, telegraph and telephone operators, and all others doing the various types of clerical and kindred work.

Skilled workers and foremen—group 4—comprise foremen and the followers of skilled trades, such as carpenters, machinists, plumbers, etc. In this group are included those occupations for the pursuance of which a long period of training or an apprenticeship usually is necessary, and which in their pursuance call for a degree of judgment and manual dexterity, one or both, above that required in semiskilled occupations. In 1930, skilled workers and foremen formed only 3.2 per cent of all Negro gainful workers.

Semiskilled workers—group 5—include machine tenders, workers in the needle trades, and, in general, workers in those manual pursuits for the pursuance of which only a short period or no period of training

[4] 1930 Census, *General Report on Occupations*, p. 74.

[5] For the occupations included in each group, see this JOURNAL, Vol. XXVIII, No. 184 (Dec. 1933), pp. 379–382.

is necessary, and which in their pursuance call for only a moderate degree of judgment or of manual dexterity. Of all Negro workers in 1930, 9.4 per cent were in semiskilled occupations.

TABLE I

NEGRO GAINFUL WORKERS IN THE UNITED STATES CLASSIFIED INTO SOCIAL-ECONOMIC GROUPS, BY SEX: 1910 TO 1930

Sex and group	Number			Per cent distribution		
	1930	1920	1910	1930	1920	1910
TOTAL	5,503,535	4,824,151	5,192,535	100.0	100.0	100.0
1. PROFESSIONAL PERSONS	115,765	77,118	64,648	2.1	1.6	1.2
2. PROPRIETORS, MGRS., & OFFICIALS	929,644	973,253	923,404	16.9	20.2	17.8
2-a Farmers (owners and tenants)	873,653	932,050	883,408	15.9	19.3	17.0
2-b Wholesale and retail dealers	28,343	23,593	20,894	0.5	0.5	0.4
2-c Other proprs., mgrs., and off.	27,648	17,610	19,102	0.5	0.4	0.4
3. CLERKS AND KINDRED WORKERS	82,669	63,095	38,698	1.5	1.3	0.7
4. SKILLED WORKERS AND FOREMEN	176,912	150,428	115,300	3.2	3.1	2.2
5. SEMISKILLED WORKERS	515,381	369,761	258,258	9.4	7.7	5.0
5-a Semiskilled workers in mfg.	181,079	161,892	107,869	3.3	3.4	2.1
5-b Other semiskilled workers	334,302	207,869	150,389	6.1	4.3	2.9
6. UNSKILLED WORKERS	3,683,164	3,190,496	3,792,227	66.9	66.1	73.0
6-a Farm laborers	1,112,510	1,198,140	1,949,848	20.2	24.8	37.6
6-b Factory & bldg. const. laborers	674,187	601,295	438,327	12.3	12.5	8.4
6-c Other laborers	516,414	446,154	389,956	9.4	9.2	7.5
6-d Servant classes	1,380,053	944,907	1,014,096	25.1	19.6	19.5
MALE	3,662,893	3,252,862	3,178,554	100.0	100.0	100.0
1. PROFESSIONAL PERSONS	55,610	39,434	35,815	1.5	1.2	1.1
2. PROPRIETORS, MGRS., & OFFICIALS	842,920	885,385	836,852	23.0	27.2	26.3
2-a Farmers (owners and tenants)	797,231	851,621	803,477	21.8	26.2	25.3
2-b Wholesale and retail dealers	24,493	20,455	17,888	0.7	0.6	0.6
2-c Other proprs., mgrs., and off.	21,196	13,309	15,487	0.6	0.4	0.5
3. CLERKS AND KINDRED WORKERS	62,138	48,047	31,926	1.7	1.5	1.0
4. SKILLED WORKERS AND FOREMEN	175,537	148,551	114,269	4.8	4.6	3.6
5. SEMISKILLED WORKERS	329,374	228,806	148,579	9.0	7.0	4.7
5-a Semiskilled workers in mfg.	104,441	91,817	53,430	2.9	2.8	1.7
5-b Other semiskilled workers	224,933	136,989	95,149	6.1	4.2	3.0
6. UNSKILLED WORKERS	2,197,314	1,902,639	2,011,113	60.0	58.5	63.3
6-a Farm laborers	693,669	667,317	979,354	18.9	20.5	30.8
6-b Factory & bldg. const. laborers	650,925	567,311	425,307	17.8	17.4	13.4
6-c Other laborers	508,754	438,157	386,263	13.9	13.5	12.2
6-d Servant classes	343,966	229,854	220,189	9.4	7.1	6.9
FEMALE	1,840,642	1,571,289	2,013,981	100.0	100.0	100.0
1. PROFESSIONAL PERSONS	60,155	37,684	28,833	3.3	2.4	1.4
2. PROPRIETORS, MGRS., & OFFICIALS	86,724	87,868	86,552	4.7	5.6	4.3
2-a Farmers (owners and tenants)	76,422	80,429	79,931	4.2	5.1	4.0
2-b Wholesale and retail dealers	3,850	3,138	3,006	0.2	0.2	0.1
2-c Others proprs., mgrs., and off.	6,452	4,301	3,615	0.4	0.3	0.2
3. CLERKS AND KINDRED WORKERS	20,531	15,048	6,772	1.1	1.0	0.3
4. SKILLED WORKERS AND FOREMEN	1,375	1,877	1,031	0.1	0.1	0.1
5. SEMISKILLED WORKERS	186,007	140,955	109,679	10.1	9.0	5.4
5-a Semiskilled workers in mfg.	76,638	70,075	54,439	4.2	4.5	2.7
5-b Other semiskilled workers	109,369	70,880	55,240	5.9	4.5	2.7
6. UNSKILLED WORKERS	1,485,850	1,287,857	1,781,114	80.7	82.0	88.4
6-a Farm laborers	41,841	530,823	970,494	22.8	33.8	48.2
6-b Factory & bldg const. laborers	23,262	33,984	13,020	1.3	2.2	0.6
6-c Other laborers	7,660	7,997	3,693	0.4	0.5	0.2
6-d Servant classes	1,036,087	715,053	793,907	56.3	45.5	39.4

The unskilled workers—group 6—include the workers in those occupations for the pursuance of which no special training, judgment, or manual dexterity is required, since the workers supply mainly muscular strength for the performance of coarse, heavy, work. In 1930, more than two-thirds (66.9 per cent) of the Negro gainful workers were unskilled.

The skilled, the semiskilled, and the unskilled are all manual workers. Almost 8 out of 10 (79.5 per cent) of the Negro workers in 1930 were in these three groups. It is quite probable, also, that most of the Negro farm owners and farm tenants are actullay engaged in manual labor, and that the Negro croppers, in the work they do, do not differ greatly from farm laborers. If the Negro farm owners and tenants be considered manual workers, then, in 1930, more than 95 out of each 100 (95.4 per cent) of the Negro workers were engaged in manual work; and if the 392, 897 Negro croppers be considered unskilled, then, in 1930, 74.1 per cent of the Negro workers were in unskilled pursuits.

During the 20-year period from 1910 to 1930, significant changes were taking place in the social-economic distribution of Negro gainful workers (see Table I). Professional persons; proprietors, managers, and officials (other than farmers); and skilled workers and foremen increased considerably in relative importance, while the relative importance of clerks and kindred workers more than doubled and the relative importance of semiskilled workers nearly doubled. But farmers were relatively less important in 1930 than in 1910, and there was a striking decline in the relative importance of farm laborers—from 37.6 to 20.2 per cent of all Negro workers. There was a considerable increase, however, in the relative importance of nonagricultural laborers and in the relative importance of the servant classes. There was a marked increase in the proportion of the Negro female workers engaged in professional pursuits, in clerical and kindred pursuits, and in servant pursuits, respectively.

If professional persons; proprietors, managers, and officials (exclusive of farmers); and clerks and kindred workers—the head workers—be combined, it develops that the proportion of the total Negro workers in these three groups increased from 2.8 per cent in 1910 to 4.6 per cent in 1930. The skilled workers and the semiskilled workers, combined, increased from 7.2 to 12.6 per cent of the total during the two decades. But notwithstanding the fact that during this 20-year period there was a gradual and important movement of Negro workers into higher social-economic groups, at the close of the period over two-thirds of them (66.9 per cent) were still in unskilled pursuits—6 out of 10 of the males and over 8 out of 10 of the females. And, as already stated, to the 66.9 per cent classified in Table I as being unskilled in 1930 doubtless might properly be added, as being likewise unskilled, the 392,897 Negro croppers, who formed 7.1 per cent of all Negro workers in 1930.

Very significant changes have been taking place in the relative importance of Negroes in the nation's labor force and in the occupational

and the social-economic distribution of Negro workers. These changes, together with prospective changes in industrial organization and the probable further mechanization of industry, indicate that future years will bring even more significant changes in the relative importance of Negro workers, in their occupational distribution, and in their social-economic status. What has the future in store for Negro workers?

Relative importance of Negro workers. At the first census of the United States, that of 1790, Negroes formed 19.3 per cent of the total population. At each succeeding census, however, except that of 1810, Negroes formed a smaller proportion of the total population. In 1930, they constituted only 9.7 per cent of the total.[6] During each decade comprised in the half century from 1880 to 1930, the per cent of increase in population was smaller for Negroes than for whites.[6] Thus, past trends appear to indicate that the relative importance of Negroes in the total population may continue to decrease, though possibly not so rapidly as in the past. The proportion Negroes formed of all gainful workers decreased somewhat gradually from 14.3 per cent in 1890 to 11.3 per cent in 1930,[7] and the population statistics, together with the occupation statistics, indicate that the relative importance of Negroes in the nation's labor force will continue to decline.

Distribution among occupational classes. During the 20-year period from 1910 to 1930 striking changes took place in the distribution of Negro workers among the main classes of occupations. The proportion engaged in agriculture decreased from 54.6 per cent to 36.1 per cent, and there was some decrease in the proportion engaged in forestry and fishing. The proportion in each of the other main classes of occupations increased, the increase being particularly large in manufacturing (from 12.6 to 18.6 per cent), in public service (from 0.4 to 0.9 per cent), in professional service (from 1.3 to 2.5 per cent), and in clerical occupations (from 0.4 to 0.7 per cent). Numerically, by far the largest increase was in manufacturing—368,750.[8]

In 1930, 76.5 per cent of the Negro gainful workers lived in the South, and of the Negro gainful workers in the South, 47.2 per cent were engaged in agriculture. A very large proportion of the Negro agricultural workers in the South are engaged in raising cotton. Until the last few years the center of cotton production was moving rapidly westward—rapidly away from the old cotton-growing States of the South and toward the newer States of Texas and Oklahoma.[9] While

[6] 1930 Census, *General Report on Population*, p. 32.
[7] 1930 Census, *General Report on Occupations*, p. 74; 1900 Census, report on *Occupations*, p. lxxxii.
[8] 1930 Census, *General Report on Occupations*, pp. 74 and 75.
[9] Between 1914 and 1929 the cotton acreage of South Carolina, Georgia, and Alabama shrank from 12.3 million to 10.0 million acres, while there was an expansion from 14.8 to 22.0 million acres of cotton in Texas and Oklahoma, *American Economic Review*, Vol. XX, No. 1, (March, 1930) p. 118.

current statistics indicate that this westward movement has been arrested, it may stop for a short period only. The Old South, in competition with Texas and Oklahoma, is handicapped, (1) by a depleted soil that necessitates the use of expensive fertilizers, (2) in some sections by a topography that requires terracing to prevent erosion, (3) in many sections by small or terraced fields that are not well adapted to extensive cultivation with large-scale labor-saving machinery, and (4) by a climate in which both the boll weevil and the weed thrive and must be held in check at considerable expense. While this handicap is partially offset by insufficient rainfall and occasional drouth in the west and the consequent smaller yield per acre there, the cost of production, is, nevertheless, considerably lower in the West than in the South.

Along with the shift in the location of the cotton growing industry has gone a striking change in the methods of production. While the Negro, the mule, and the one-mule plow, so common on the old cotton plantations, are there beginning to give place to improved machinery, on the large farms of Texas and Oklahoma the tractor, the gang plow, and the multiple-row cultivator are already in common use; and in these newer fields the mechanical cotton picker threatens to displace the hand picker.

With the probable future rapid increase in the use of machinery in agriculture, particularly in cotton growing, and with the possible renewal of the western trend of the center of cotton production, it seems quite likely that the proportion of the Negro workers engaged in agriculture will continue to decrease rapidly, and that there will be a continued increase in the proportion of them engaged in some of the other occupational fields. And since the South is and for many years probably will continue to be devoted largely to agriculture, it seems quite likely that, in quest of employment in other fields, large numbers of Negro workers will in future years migrate from the South to other sections of the country. Such a migration, to the extent that it became extensive, would mean a geographical redistribution of the Negro population; and it would bring to other sections of the country Negro population, occupation, political, and social problems which, for the most part, have been confined to the South.

Changes in social-economic groups. What do present trends indicate as to future changes in the social-economic status of Negro gainful workers? The unskilled have always formed a very large proportion of the Negro workers, and today the great mass of them are in unskilled occupations. "Mechanization probably has advanced most rapidly in the field of unskilled labor; and probably this will be the

field of its greatest future development. More and more the unskilled workers compete with the latent energy stored in a lump of coal or in a gallon of oil or of gasoline, or in the force of gravity exerted through the streams and the tides."[10]

It seems quite probable that the machine will gradually take over and do much of the work now being done by unskilled Negro workers. Should the further mechanization of industry largely displace the Negroes in their present unskilled occupations, what will become of them? Evidently, a large proportion of them must either advance to higher occupations, take over unskilled work being done by white laborers, or else be without work.

Will the Negro workers, as a class, be able to enter or to advance to higher occupations as rapidly as the increase in the mechanization of industry and the improvement in technological processes take from them the unskilled work most of them are now doing?

While the proportion of Negro workers engaged in professional pursuits; proprietary, official, and supervisory pursuits (except farmers); clerical pursuits; skilled pursuits; and semiskilled pursuits has been increasing (see Table I), this increase has not been rapid—only from 10 per cent of all Negro workers in 1910 to 17.2 per cent in 1930. And while the proportion of unskilled among Negro workers has been decreasing, this decrease has been less rapid than has the corresponding decrease among other workers. Thus, the proportion of unskilled among Negro workers (not including croppers) decreased from 73.0 per cent in 1910 to 66.9 per cent in 1930, while the proportion of unskilled among other workers decreased from 31.7 per cent in 1910 to 23.8 per cent in 1930. In 1930, the proportion unskilled was over three times as large among Negro workers as among native white workers.

To what extent is the large proportion of Negro workers in unskilled occupations due to the fact that they largely live in the South,[11] where much of the work is unskilled and where prejudice against Negroes' training for and entering higher pursuits may be stronger than in other sections of the country?

Between 1910 and 1930, a large number of Negro workers migrated from the South to northern cities. Since these Negroes probably included a much smaller proportion of children and of old persons than did the Negro workers of the South, it might be expected that the proportion of the workers engaged in unskilled pursuits would be considerably smaller among the Negroes of the North than among those of the South, even without allowance for any greater freedom the Negroes

[10] Present writer, *Annals of the American Academy of Political and Social Science*, Vol. 184 (Mar. 1936), p. 19.

[11] As stated on p. 534, 76.5 per cent of the Negro gainful workers lived in the South in 1930.

of the North may have had in advancing to higher occupations. What do the statistics show? The Negro gainful workers in each of four Northern cities—Chicago, Detroit, Manhattan Borough of New York,

TABLE II

NEGRO GAINFUL WORKERS CLASSIFIED INTO SOCIAL-ECONOMIC GROUPS, BY SEX, FOR THE UNITED STATES, FOR FOUR NORTHERN CITIES AND FOUR SOUTHERN CITIES: 1930

(Percentage not shown where less than 0.1)

Sex and group	United States		Northern Cities		Southern Cities	
	Number	Per cent	Number	Per cent	Number	Per cent
TOTAL	5,503,535	100.0	449,118	100.0	218,683	100.0
1. PROFESSIONAL PERSONS	115,765	2.1	11,788	2.6	5,540	2.5
2. PROPRIETORS, MGRS., & OFFICIALS	929,644	16.9	8,186	1.8	3,870	1.8
2-a Farmers (owners and tenants)	873,653	15.9	201	—	442	0.2
2-b Wholesale and retail dealers	28,343	0.5	4,116	0.9	2,076	0.9
2-c Other proprs., mgrs., and off.	27,648	0.5	3,869	0.9	1,352	0.6
3. CLERKS AND KINDRED WORKERS	82,669	1.5	23,742	5.3	4,936	2.3
4. SKILLED WORKERS AND FOREMEN	176,912	3.2	28,561	6.4	13,859	6.3
5. SEMISKILLED WORKERS	515,381	9.4	92,467	20.6	40,020	18.3
5-a Semiskilled workers in mfg.	181,079	3.3	39,058	8.7	12,156	5.6
5-b Other semiskilled workers	334,302	6.1	53,409	11.9	27,864	12.7
6. UNSKILLED WORKERS	3,683,164	66.9	284,374	63.3	150,458	68.8
6-a Farm laborers	1,112,510	20.2	783	0.2	2,132	1.0
6-b Factory & bldg. const. laborers	674,187	12.3	66,002	14.7	30,188	13.8
6-c Other laborers	516,414	9.4	46,129	10.3	30,800	14.1
6-d Servant classes	1,380,053	25.1	171,460	38.2	87,338	39.9
MALE	3,662,893	100.0	288,035	100.0	128,549	100.0
1. PROFESSIONAL PERSONS	55,610	1.5	7,261	2.5	2,358	1.8
2. PROPRIETORS, MGRS., & OFFICIALS	842,920	23.0	7,147	2.5	3,248	2.5
2-a Farmers (owners and tenants)	797,231	21.8	196	0.1	406	0.3
2-b Wholesale and retail dealers	24,493	0.7	3,780	1.3	1,840	1.4
2-c Other proprs., mgrs., and off.	21,196	0.6	3,171	1.1	1,002	0.8
3. CLERKS AND KINDRED WORKERS	62,138	1.7	18,567	6.4	3,689	2.9
4. SKILLED WORKERS AND FOREMEN	175,537	4.8	28,132	9.8	13,771	10.7
5. SEMISKILLED WORKERS	329,374	9.0	47,972	16.7	26,459	20.6
5-a Semiskilled workers in mfg.	104,441	2.9	18,281	6.3	7,216	5.6
5-b Other semiskilled workers	224,933	6.1	29,691	10.3	19,243	15.0
6. UNSKILLED WORKERS	2,197,314	60.0	178,956	62.1	79,024	61.5
6-a Farm laborers	693,669	18.9	768	0.3	1,931	1.5
6-b Factory & bldg. const. laborers	650,925	17.8	64,771	22.5	28,935	22.5
6-c Other laborers	508,754	13.9	45,196	15.7	30,131	23.4
6-d Servant Classes	343,966	9.4	68,221	23.7	18,027	14.0
FEMALE	1,840,642	100.0	161,083	100.0	90,134	100.0
1. PROFESSIONAL PERSONS	60,155	3.3	4,527	2.8	3,182	3.5
2. PROPRIETORS, MGRS., & OFFICIALS	86,724	4.7	1,039	0.6	622	0.7
2-a Farmers (owners and tenants)	76,422	4.2	5	—	36	—
2-b Wholesale and retail dealers	3,850	0.2	336	0.2	236	0.3
2-c Other proprs., mgrs., and off.	6,452	0.4	698	0.4	350	0.4
3. CLERKS AND KINDRED WORKERS	20,531	1.1	5,175	3.2	1,247	1.4
4. SKILLED WORKERS AND FOREMEN	1,375	0.1	429	0.3	88	0.1
5. SEMISKILLED WORKERS	186,007	10.1	44,495	27.6	13,561	15.0
5-a Semiskilled workers in mfg.	76,638	4.2	20,777	12.9	4,940	5.5
5-b Other semiskilled workers	109,369	5.9	23,718	14.7	8,621	9.6
6. UNSKILLED WORKERS	1,485,850	80.7	105,418	65.4	71,434	79.3
6-a Farm laborers	418,841	22.8	15	—	201	0.2
6-b Factory & bldg. const. laborers	23,262	1.3	1,231	0.8	1,253	1.4
6-c Other laborers	7,660	0.4	933	0.6	669	0.7
6-d Servant classes	1,036,087	56.3	103,239	64.1	69,311	76.9

and Philadelphia—and those in each of four Southern cities—Atlanta, Birmingham, Memphis, and New Orleans—were classified into social-economic groups. The results are presented in Table II.

The percentages given in Table II show that in 1930 there were some real differences between the Northern cities and the Southern cities in the social-economic distribution of Negro workers. These differences were not the same for each sex, however. The proportion of the males engaged in professional pursuits was considerably larger in the Northern than in the Southern cities, but the reverse was true of the females. In the case of each sex, the proportion in clerical pursuits was much larger in the Northern than in the Southern cities. It is interesting to note that the proportion of the male workers in skilled pursuits and in semiskilled pursuits was smaller in the Northern than in the Southern cities, and that the reverse was true of female workers. The proportion of the workers engaged in unskilled pursuits was somewhat higher

TABLE III

NUMBER AND PROPORTION OF NEGRO GAINFUL WORKERS UNSKILLED, BY SEX, FOR THE UNITED STATES, FOR FOUR NORTHERN CITIES AND FOUR SOUTHERN CITIES: 1930

Area	Male			Female		
	Total workers	Unskilled workers		Total workers	Unskilled workers	
		Number	Per cent		Number	Per cent
United States	3,662,893	2,197,314	60.0	1,840,642	1,485,850	80.7
Four Northern Cities	288,035	178,956	62.1	161,083	105,418	65.4
Chicago, Ill.	85,046	50,934	59.9	44,421	25,827	58.1
Detroit, Mich.	44,916	29,598	65.9	15,381	11,178	72.7
Manhattan Borough, N. Y.	81,912	48,421	59.1	58,552	36,551	62.4
Philadelphia, Pa.	76,161	50,003	65.7	42,729	31,862	74.6
Four Southern Cities	128,549	79,024	61.5	90,134	71,434	79.3
Atlanta, Ga.	26,332	15,684	59.6	24,285	19,766	81.4
Birmingham, Ala.	30,932	18,772	60.7	18,067	14,446	80.0
Memphis, Tenn.	31,773	20,493	64.5	20,251	15,855	78.3
New Orleans, La.	39,512	24,075	60.9	27,531	21,367	77.6

for males in the Northern than in the Southern cities, but was much higher for females in the Southern than in the Northern cities. As shown by Table III, the proportion in unskilled pursuits was particularly high for males in Detroit and Philadelphia and for females in Atlanta and Birmingham. In each group of cities, and in 5 of the 8 cities taken separately, the proportion of males in unskilled work, if croppers be omitted, was higher than in the United States as a whole. If, however, croppers be classed as unskilled then the proportion of all male Negro workers in unskilled pursuits in 1930 was much higher in the entire United States (approximately 70 per cent) than in any of the 8 cities.

The statistics presented in Tables II and III do not indicate that the principal reason so large a proportion of the Negro male workers of

the United States are in unskilled pursuits is because so large a proportion of them live in the agricultural South. The statistics do appear to indicate that the movement of Negro males to the cities, both in the North and in the South, has accelerated their movement into intellectual pursuits and into the higher manual pursuits. This is suggested by a comparison of the percentages presented in Table II for the United States with those there presented for the two groups of cities. It may be, however, that the Negro males who moved to the cities were a selected class and that this accounts, in part at least, for the larger proportion of the city workers in the higher pursuits in 1930.

On the whole, the social-economic status of Negro female workers in 1930 appears to have been considerably higher in the four Northern cities than in the four Southern cities. Were the occupational opportunities for Negro women greater in the Northern cities, or were the Negro women living in these cities more capable than those living in the Southern cities? Unfortunately, our present statistics do not fully answer these two questions. The variety of occupations pursued by Negro women in 1930 appears to have been considerably greater in the Northern than in the Southern cities, and the percentage of illiteracy in the Negro population was only about one-fifth as large in the Northern as in the Southern cities.

Doubtless, lack of the requisite education has in some measure prevented Negro workers from entering the higher manual pursuits and intellectual pursuits. The percentage of illiteracy among persons 10 years old and over in 1930 was 16.3 for Negroes, as compared with 2.7 for whites; and the percentage of persons 5 to 20 years old attending school in 1930 was 60.0 for Negroes, as compared with 71.5 for whites.[12] With increased educational opportunities—particularly opportunities for vocational training—and with opportunity to enter all occupations freely, a larger proportion of the Negroes will qualify for the higher occupations.

If the Negro workers are not able to advance to higher pursuits as rapidly as the machine takes over and does the unskilled work they are now doing, or if they are not able to compete with the usually better educated white workers in the higher pursuits, will they take over much of unskilled work being done by white workers?

In 1930, Negroes formed only 26.3 per cent of all unskilled workers. If, in the future, the demand for unskilled workers should decrease rapidly, it is quite probable that with this decrease many of the unskilled Negro workers who could not qualify for higher pursuits would take the places of unskilled white workers who could.

[12] 1930 Census, *General Report on Population*, pp. 1094 and 1219.

During the two decades from 1910 to 1930, the total number of unskilled workers in the United States decreased only from 14,251,589 to 14,008,869, or only 242,720. This fact indicates strongly that for many decades to come Negro unskilled workers (numbering only 3,683,164 in 1930 or 4,076,061, if the 392,897 croppers be included) probably will not be numerous enough to supply more than one-third of the total demand for unskilled workers. Nevertheless, many unskilled Negro workers may be without work in the future.[13] First, the unskilled white workers may not shift to higher pursuits rapidly enough to relinquish unskilled jobs for all the unskilled Negro workers displaced by the machine. Large numbers of white laborers may not wish to leave the farm for the city, even though qualified for higher pursuits. Second, lack of perfect mobility will result in Negro laborers not getting nearly all of the available unskilled work. For example, because of the possible renewal of the shift of cotton growing from the Old South to the newer fields of Texas and Oklahoma and because of the lack of perfect mobility of Negro workers, it seems quite possible that unemployment of unskilled Negro workers in the Old South may in future years be large and somewhat continuous. And it seems quite probable that in times of depression problems of unemployment and relief may be particularly grave among the unskilled Negro workers in our large cities.

Is there real danger that in future years there will be large numbers of unemployed Negro workers and that these and their dependents will largely comprise the permanently unemployed class certain writers have prophesied that we shall have? Indeed, may it possibly come to pass that a century after a war was fought largely to free the Negro slaves the descendants of the slave owners, along with other white persons, will be working to support on a permanent dole large numbers of the descendants of the former slaves?

While it now seems possible that in the future large numbers of the Negroes in some sections will be on relief for a time because they have been displaced in unskilled work by machines and are unable to rise to higher pursuits or do not find other unskilled work, the probabilities are that such conditions will not be general or permanent. The statistics here presented for the 20-year period 1910 to 1930 show a gradual upward trend in the social-economic status of Negro gainful workers. This trend doubtless will continue, though, as in the past, the shift to higher social-economic groups probably will be rather slow and it may be accompanied by considerable unemployment and relief.

[13] While the percentage of the total workers engaged in unskilled pursuits decreased from 37.3 in 1910 to 28.7 in 1930, the percentage Negroes formed of the total unskilled workers decreased from 26.6 in 1910 to 26.3 in 1930.

THE SWEDISH CENSUS OF 1935–6*

By Dorothy Swaine Thomas
Yale University

The Swedish Census of 1935–6 is remarkable in several respects: (1) It was motivated by the Population Commission appointed by the Riksdag in May 1935. The function of this commission was to investigate what is widely recognized as a "population crisis" and to make recommendations about future population policy. One of the Commission's first recommendations was that a special census be organized to provide a factual basis for later recommendations on matters of policy. (2) It involved a combination of an indirect census, i.e., a balance sheet drawn from the population registers, and a direct enumeration of certain data. This latter is the first attempt at a direct census ever made in Sweden. (3) It involved a combination of a complete enumeration of the population for the indirect census, and the sampling of about 20 per cent of the population for the direct census.

The aim of the Population Commission, in proposing this census, was to produce detailed and relevant data to indicate the trend in population development, and by combining demographic with social and economic factors to indicate the environmental situations which might be operating upon the people's will and capacity to marry and bear children. Since the data necessary to fulfill this aim could not be readily obtained from a single source, the census was so organized as to tap what were considered to be the most reliable sources for each class of data required. Thus the purely demographic data (date and place of birth, civil status, date of marriage and dissolution of marriage, etc.) could be obtained with the highest degree of accuracy from the population registers, where each such fact is recorded at the time it occurs. Data on income and property could be secured with the greatest reliability from the income tax authorities, where the tax declarations are checked against other sources. On the other hand, much of the data necessary for this investigation could be obtained only by direct questioning of the population. These data were mostly those relating to development rather than present status, e.g., the number of children ever born in a marriage, changes of occupation, etc., but also included a few status questions, e.g., present occupation, which was considered to be unreliably recorded in the population registers.

* I am indebted to Dr. Ernst Höijer, Acting Chief of the Central Statistical Bureau, and to Mr. J. Sjöstrand, Supervisor of the Census, for making available the details regarding the Census and for reading this note in manuscript.

The indirect census of 1935–6 represented a complete enumeration of the population, and was directed towards two ends, (1) the determination of the age distribution by sex and civil status for each community and (2) through the identification of all the population in terms of name and residence to serve as a basis from which samples could be drawn for the direct census. The chief reasons for sampling rather than complete enumeration in the direct census were practical considerations: the necessity of getting the data as quickly and cheaply as possible and the necessity of using only qualified enumerators because of the complexity of the questions.

The indirect census was merely a simplified form of the usual decennial census and the procedure was the same as that used since 1860. This census is a balance sheet drawn from the population registers by the pastors of the Swedish State Church, who are charged with the keeping of the registers.[1] It indicates the legal population of each community as of December 31, 1935. A schedule was filled in for every household and included the following data for each member of the household: Name, family status (relationship to head of household), sex, occupation, physical defects (blind, deaf and dumb, imbecile, insane, epileptic), date of birth, place of birth, civil status, date of marriage, date of dissolution of marriage, whether the person was temporarily absent from the community of residence, and the address of the spouse in case of marriage separation.

After these schedules were assembled, samples were drawn from them for the direct enumeration. For the larger cities (population 20,000 or more) every fifth household was selected from the indirect schedules which were arranged in the order in which they had been filled in from the population registers, i.e., according to addresses. Lots were drawn separately for each city to indicate which household among the first five should be taken as the first household in the sample, and thereafter each fifth household was selected. Of the smaller towns and rural communities (which numbered about 2,500), one in every five communities was selected and every household investigated. The sampling of rural communities was made after the communities had first been stratified into three classes according to the occupational distribution of the population at the time of the 1930 census: agricultural communities in which at least 75 per cent of the population was occupied in or dependent upon farming, rural mixed communities in which the proportions engaged in farming were from 50 to 75 per cent, and rural industrial communities in which the proportion engaged in farming represented less than 50 per cent. Within each

[1] Civil registration exists only in Stockholm.

stratum of each county (Sweden is divided into 24 counties of *län*) the communities were arranged in order according to their geographical position in the county, and every fifth community in each stratum selected for the sample, lots being drawn for each group to determine which community should be the first to be drawn within the group. It was recognized that it might have been theoretically more desirable to sample one in every five households for all rural communities, but practical considerations of time and money dictated this other plan. One of the interesting by-products will be an empirical test of the validity of this sampling procedure by comparing the sample with the known universe.

After the sample for the direct enumeration had been drawn, the details obtained through the indirect census were entered on the new schedules. Thus the accuracy of the purely demographic data was insured and direct questioning on this point, except for purposes of identification, was avoided. The only exception to this rule was in regard to occupation, on which point the population registers are known to be incomplete and unreliable.

The questions on the direct schedule were organized around three main points: Economic Status and Occupational History, Children Born to Spouses Living Together at the time of the Census, and Housing Conditions.

The questions on economic status included: chief occupation, status in occupation, industry (and, in the case of employers, the number of persons employed), whether the occupation was carried on in or away from home, subsidiary occupations (in the case of married women, whether they acted as assistants to their husbands), occupation and occupational status in 1930. In addition, there were extra questions for special classes of persons: for spouses living together at the time of the census, occupation and status in occupation at the time of or shortly before marriage; for all persons over 15 years of age, education and vocational training; for all persons aged 16–66 years, occupational disability (whole or partial), whether unemployed on March 2, 1936, and total number of weeks unemployed during 1935; for all women whose present marriages were contracted after 1900 and who were living with their husbands at the time of the census, whether they gave up their jobs upon marrying, whether they migrated in connection with marriage, and the details of their occupational history since marriage.

The questions relating to the number of children ever born were limited to married spouses living together at the time of the census. Demographic details were entered for children who had died or left

home. Children of the husband and wife (in common) born before marriage were entered on the schedule as well as those born during marriage.

The questions relating to housing conditions included: the number of "real" living rooms (defined as of a minimum size, with windows or ventilation, a door that can be closed and some sort of heating); the number of "other" living rooms; the nature of the kitchen; the existence of bath room, shower room, hall, vestibule; the number of lodgers and the quarters occupied by them; the existence of a kitchen garden.

The direct census was taken in the cities from March 16 to March 31; in rural communities from March 6 to March 13, 1936. Before the enumeration began, duplicate schedules were sent out to every household included in the sample. At the same time, nation-wide propaganda was carried on, and two radio talks were held, one indicating the purpose of the census, the other explaining in detail what the separate questions meant. Thus, by the time the enumerators arrived, many of the duplicate schedules had already been completely filled in, and the enumerator's function was in these cases limited to checking up on the more difficult points.

Data on income and property for the year 1935 were entered directly on the schedules by the county tax authorities.

Taken as a whole, this census is one of the most interesting experiments in the collection of mass statistics that has ever been carried out. It was motivated by the need for information bearing on an important social problem, the questions were organized around this problem, and all available resources were used to get the desired information quickly, efficiently and reliably. The usually troublesome data on age, civil status, etc., were taken from the parish registers, the accuracy of which is unquestioned on purely demographic lines; the developmental data, relating to occupational history and the number of children ever born were obtained from the only possible source, the people themselves, and they were prepared in advance for the questions that would be asked; the housing data were checked by the observing enumerators, and the income tax data were entered from the official tax records. The combination of the direct and indirect methods of enumeration should, to some extent, act as a check on both. The combination of a sampling procedure with a complete enumeration will make possible a test of the representative nature of the sample and has a theoretical interest as well as a practical utility as a guide to the type of inference that can be drawn from the sample.

RATES OF MENTAL DISEASE AMONG CERTAIN POPULATION GROUPS IN NEW YORK STATE

By Benjamin Malzberg
New York State Department of Mental Hygiene

Considerable attention has been directed to the problem of the relative frequency of mental disease among native and foreign-born in the United States. Interest was centered, at first, upon the economic costs of mental disease, and the consequent burden imposed by the foreign element of the population. In recent years the eugenic argument has been superimposed upon the economic, and it has been set forth that immigrant populations not only have higher rates of mental disease than the native population, but that the differences are correlated with the racial compositions of the several groups.

Because of the importance of the problem, both economically and biologically, the present writer undertook a systematic analysis of the basic data, and showed that the differences in rates of mental disease between native and foreign-born whites in New York State are due primarily to variations in age composition.[1,2] 'Crude' rates for the two groups differ in the ratio of more than 2 to 1. Adjustment for the obvious age differences reduced the disparity, however, so that the rate of the foreign-born appeared in excess by only twenty per cent.[2] Another adjustment with respect to environmental factors—such as urban-rural distribution—reduced the difference in rates still further, so that the writer felt able to suggest that the remaining difference could easily be accounted for on the basis of environmental circumstances, rather than on the hypothesis of racial diversity between the two groups.[3] In the following note I wish to present additional data which enhance the probability of the environmental explanation.

In 1915 Dr. A. J. Rosanoff showed that during the biennial period ending June 30, 1910, native Californians had an admission rate to institutions for mental disease of 70.7 per 100,000 corresponding general population. Residents of California who had migrated from New York State had a corresponding rate of 183.8, the latter being in excess in the ratio of 2.6 to 1.[4] Since these were all native-born Americans,

[1] Benjamin Malzberg, "Mental Disease and the Melting Pot," *Journal of Nervous and Mental Disease*, Vol. 72, No. 4, October, 1930.

[2] Benjamin Malzberg, "Mental Disease in New York State According to Nativity and Parentage," *Mental Hygiene*, Vol. 19, No. 4, October, 1935.

[3] Benjamin Malzberg, "Mental Disease Among Native and Foreign-born Whites in New York State," to be published in *American Journal of Psychiatry*.

[4] A. J. Rosanoff, "Some Neglected Phases of Immigration," *American Journal of Insanity*, Vol. 72, July, 1915.

the racial factor was presumably constant, and Dr. Rosanoff therefore concluded that the differences in rates of mental disease must be due to the social and economic factors which are associated with migration.

It is possible to present a similar analysis for New York State on a larger scale. During the three fiscal years ending June 30, 1931, there were admitted to all institutions for mental disease in New York State a total of 15,704 native white first admissions. Of these 10,316, or 65.7 per cent, were born in New York State, and 5,388, or 34.3 per cent, were born elsewhere in the United States. The former had an average annual rate of first admissions of 44.6 per 100,000 corresponding general population. The latter had a rate of 156.9, which exceeded the former rate in the ratio of 3.5 to 1.

TABLE I

NUMBER OF NATIVE WHITE FIRST ADMISSIONS TO ALL HOSPITALS FOR MENTAL DISEASES IN NEW YORK STATE, 1929–1931

Psychoses	Number		Average annual rate per 100,000 general population	
	Born in New York State	Born in other States	Born in New York State	Born in other States
With cerebral arteriosclerosis	1,252	705	5.4±0.2	20.5±0.9
General paresis	881	524	3.8±0.1	15.3±0.8
Alcoholic	512	327	2.2±0.1	9.5±0.6
Manic-depressive	1,344	797	5.8±0.2	23.2±0.9
Dementia praecox	2,894	1,392	12.5±0.3	40.5±1.3
All psychoses	10,316	5,388	44.6±0.5	156.9±2.4

Of the native white population resident in the State of New York on April 1, 1930, 49.9 per cent were of native parentage, and 50.1 per cent of foreign or mixed parentage. We have no separate data for those resident in New York State on April 1, 1930, who came from other states, but it is reasonable to assume that they approximate to the distribution for the entire country with respect to parentage. Of the latter group, 73.4 per cent of the native whites were of native parentage, and only 26.6 per cent of foreign or mixed parentage.[5] It has been shown that natives of native parentage have lower 'crude' rates of mental disease than natives of foreign or mixed parentage.[6] Consequently residents of New York State born in other states should have had a lower rate of first admissions than natives of New York State, other things being equal. Nevertheless, the latter had a decidedly lower 'crude' rate. The conclusion must be drawn that the dominant factor was not racial composition, but the difficulties of social and economic adjustment associated with migration.

Table I gives rates of first admissions for several of the more important groups of psychoses.

[5] From *Fifteenth Census of the United States, 1930*, Vol. II, page 36.
[6] See reference (2) above.

In connection with each group of psychoses, white residents of New York State, born in other States, had a rate greatly in excess of that of the group born in New York State. Among the psychoses with cerebral arteriosclerosis the rates were in the ratio of 3.8 to 1. In general paresis and the manic-depressive psychoses, the rates were in the ratio of 4.0 to 1. Those born in other states had a rate of first admissions with dementia praecox in excess in the ratio of 3.2 to 1. The greatest disparity occurred in connection with the alcoholic psychoses. Those born in other states had a rate in excess in the ratio of 4.3 to 1.

The rates included in Table I are 'crude' rates. Owing to the absence of census data with respect to the age composition of the two groups it is impossible to prepare standardized rates of first admissions. However it is unlikely that age is the determining factor in the production of the differences, as may be seen from the data in Table II.

TABLE II

AGE CONSTANTS OF THE NATIVE WHITE FIRST ADMISSIONS TO ALL INSTITUTIONS FOR MENTAL DISEASE IN NEW YORK STATE, 1929–1931

Psychoses	Born in New York State		Born in other States	
	Average age (years)	Standard deviation (years)	Average age (years)	Standard deviation (years)
With cerebral arteriosclerosis	67.6±0.1	9.4±0.1	65.5±0.2	9.3±0.1
General paresis	43.9±0.3	11.0±0.2	43.9±0.3	10.4±0.2
Alcoholic	45.2±0.3	10.9±0.2	45.2±0.4	10.9±0.3
Manic-depressive	37.7±0.3	14.5±0.2	35.1±0.3	13.0±0.2
Dementia praecox	40.0±0.1	11.6±0.1	31.6±0.2	10.8±0.1
All psychoses	44.2±0.1	18.2±0.1	43.7±0.2	18.1±0.1

First admissions who were natives of New York State had a slightly higher average age than those born in other States, though the difference is not statistically significant. They had equivalent averages in general paresis and the alcoholic psychoses. They had higher averages with respect to psychoses with cerebral arteriosclerosis, manic-depressive psychoses and dementia praecox. Were the first admissions drawn randomly from the parent populations, it is therefore probable that the general population of native whites born in New York State was slightly older than that born in other States. This would tend to raise the rate of first admissions, since such rates increase with age. On the other hand, it is highly probable that the population born in New York State includes a higher proportion in the very young age groups (i.e., those under 15 years of age). This would tend to reduce the average rate of first admissions for the group, since rates of first admissions are lowest at the youngest age levels. However, when we balance the probable youthful proportion in the indigenous population against that in the older age groups, and consider the great excess in the average rate

of the migratory group, it does not appear likely that age differentials could account for the great disparity in rates of first admission shown above.

The rates are also influenced by the urban-rural distributions of the two groups. Urban rates of first admissions exceed rural rates. It is probable that the migrant group includes a higher proportion of urban dwellers than the indigenous population. In the absence of the essential census data, we are again unable to introduce necessary statistical corrections. However, we are able to approximate a constant distribution with respect to environment by a consideration of rates of first admissions among native-born negroes in New York State.[7] The negro population is concentrated very heavily in New York City, which included 79 per cent of the total negro population of the State. In comparing negroes born in New York State with those born in other parts of the United States, the difference in environmental distribution is therefore largely eliminated. The indigenous group, however, had an average annual rate of first admission of 40.0, the migratory group a rate of 186.2. The latter is in excess in the ratio of 4.7 to 1. Obviously, therefore, the differences in rates of mental disease between the indigenous and migratory populations cannot be explained as statistical artifacts, arising from differential distributions with respect to age or environment. The true rates among the migratory and native white group may be in a ratio less than that indicated by the 'crude' rates, but it is hardly likely that the difference could be eliminated by statistical adjustments.

We must conclude, therefore, that the resident white population of New York State born in that State had lower rates of first admissions than the resident population born in other States. As noted previously, the former group should have had higher rates (other things being equal), since it includes a relatively higher proportion of natives of foreign or mixed parentage. The lower rates must therefore be attributed to the generally more favorable circumstances of life surrounding the indigenous population, as contrasted with a migrating population.

[7] "Migration and Mental Disease Among Negroes in New York State," *American Journa of Physical Anthropology*, Vol. 21, No. 1, January, 1936.

A BROADENED PROGRAM OF BANK REPORTS*

By Mortimer J. Fox, Jr.
Chief, Division of Research and Statistics, Federal Deposit Insurance Corporation

Within the past two years there have occurred three significant developments in the field of banking statistics. These have been, first, the introduction of the Federal Deposit Insurance Corporation into the field of bank supervision; second, the movement towards simplification and standardization of bank report requirements; and, third, the "statistification," for the first time, of reports of examination of banks.

The Comptroller of the Currency and the Federal Reserve Board have for many years required regular and uniform reports of condition and of earnings, expenses, and dividends from the banks under their immediate jurisdiction. Only the most fragmentary information has been available, however, for the more than 50 per cent of the nation's banks which are not affiliated with the Federal Reserve System. It has been the practice of the Comptroller of the Currency annually to assemble from State banking supervisors condensed summaries of bank condition statements which have made possible the publication of a June 30 "all banks" condition series. By abstracting the annual reports of state banking departments, the Federal Reserve Board has been able to maintain an almost comparable series as of December 31. The value of these data has been lessened by a number of factors: First, there is little uniformity among the state supervisors as to the dates of their calls. Second, there is little uniformity as to the contents of state supervisors' reports. Third, the devious methods required to assemble the data at a central point for tabulation make it impossible to publish the information much sooner than a year after the date of call. Information concerning earnings and expenses of banks not members of the Federal Reserve System has never been collected by these agencies.

Since the advent of the Federal Deposit Insurance Corporation, however, this situation has been considerably altered. Individual reports of condition are now submitted to Federal agencies upon a standard form twice each year by more than 93 per cent of the commercial banks of the country. Individual operating statements covering the annual earnings, expenses, and dividends of these same banks have also become available.

* Revision of a paper presented at the Ninety-seventh Annual Meeting of the American Statistica Association, New York City, December 30, 1936.

I have always felt that bankers would profit from a more extensive application of statistical methods to their own problems. It seems quite anomalous that the men who rely so implicitly in appraising credit risks upon such devices as the common-size condition and operating statements developed by Robert Morris Associates and others should display so little interest in developing some similar yardstick for their own institutions. In its periodical abstracts of call reports and in its Annual Report, the Federal Deposit Insurance Corporation has already published elementary devices of this type. With current condition and operating statements available for over 14,200 banks, we hope in the near future to be able to build up comprehensive data on "typical" banks, adjusted both for size of bank and for geographic factors. It is anticipated that these data will afford effective instruments of supervision, and I am sure that bankers will welcome their appearance.

With the exception of certain analyses of small, selected groups of banks, little has been done with the earnings and expense data reported by the banks of the country. Since one of the primary interests of the Federal Deposit Insurance Corporation is the successful operation of the banks whose deposits it insures, it is imperative that we be able to measure the operating efficiency of banks as it is reflected in their reports of earnings and dividends. With the cooperation of the Federal Reserve Board, the Corporation has undertaken to analyze the earnings experience of all insured state banks. Preliminary results of this analysis also were published in the Annual Report of the Corporation. The data have been related to condition figures and significant operating ratios developed for banks of various sizes. Additional ramifications of this problem are currently being explored, and it is hoped that within a short while there will have been developed a refined and comprehensive technique which will be productive of a wealth of information to students of banking.

The Federal Deposit Insurance Corporation has made every effort to lessen for its banks the task of reporting to authorities. Prior to each of our calls the Corporation has communicated with each state supervisor, offering to supply him with enough of our blanks so that his banks could satisfy both call requests by submitting duplicate copies of the one report. The response to these suggestions has been most gratifying. About 30 states are using forms supplied by the Federal Deposit Insurance Corporation or which are almost exact duplicates of the forms used by Federal agencies.

Bank condition data have been criticized as not comparing favorably with corresponding data for other industries. The ground for criticism

has been that book condition figures, which are all that have been made public in the past, bear no measurable relation to the actual *net* condition of banks.

The only reliable source of information concerning the net condition of a bank is the report of examination of that bank. Despite the obvious factors which complicate statistification of these reports—such as the varying dates of examination and the presence of the personal element in the examiner's appraisal—the Federal Deposit Insurance Corporation undertook early in 1935 to tabulate and analyze the reports of examination of the 7,500 insured banks not members of the Federal Reserve System. The results of this analysis, which is the first of its kind, were published in the Annual Report of the Corporation for 1934. So far, only the surface of this new mine of information has been tapped. We have learned, for example, the number of banks which are operating without any net sound capital, and are, therefore, technically insolvent. The analysis will make it possible to determine the current trend of the condition of bank assets. It is also possible, with these new data, to determine the relative degrees of risk attached to various types of bank investments, such as loans, investments, and other assets.

The potentialities of this new field of financial statistics seem to be unlimited. In the past, bank supervisors have had to base their policy decisions with reference to bank regulation upon their personal acquaintance with a limited number of banks. From this new information it may be possible to develop a tool which will enable supervisors to apply scientific methods to their problems of policy. The results of this type of analysis should make it possible eventually to minimize the effect of the personal element in bank examinations and to place this instrument of supervision and control upon a more objective basis. The data should prove very helpful in the development of the "typical" bank studies which I have mentioned elsewhere. Finally, and perhaps most important, the analysis of examination reports, to the extent that it reflects the true credit picture in local institutions throughout the country, should help materially in the formulation of general monetary and credit policies by the central bank authorities.

NOTES

THE STATISTICAL WORK OF THE NATIONAL FERTILIZER ASSOCIATION

When The National Fertilizer Association was formed in 1925 as a consolidation and successor of preceding organizations which had been functioning as active trade associations since 1883, definite provision was made in the Association's program for statistical research in the problems of the fertilizer industry and the issuance of statistical reports for the use of members of the Association and others who might have an interest in the industry's operations. The program which was formulated eleven years ago has been expanded since that time, with no important phase of the statistical work of the Association having been curtailed during the depression.

The industry statistics which had been regularly compiled for a number of years proved particularly helpful at the time of the adoption of the NRA Code and during the period of codal operation. The relatively large measure of success of such operation can be attributed in part to the fact that there was an adequate statistical basis for industry planning.

As one of its early activities the Association compiled and began the regular publication of the first comprehensive weekly, wholesale commodity price index available in this country. This index, based largely on prices as of Thursday, Friday, and Saturday, is released to the press and news ticker services on the following Monday forenoon, appears each week in *The N.F.A. News*, the official news organ of the fertilizer industry, and is reviewed each month in the *Price Index Service Letter* issued by the Association. The index contains the only series of mixed fertilizer prices which is compiled continuously, the only comprehensive weekly index of fertilizer material prices, and weekly indexes of farm product prices by groups. In addition to the all-commodity index, eleven group indexes and five subgroup indexes are compiled and released each week.

The most complete and comprehensive record available on the monthly trend of fertilizer sales is that contained in the Association's report on fertilizer tax tag sales in 17 states. Since these states account for approximately 70 per cent of the fertilizer sold in the entire country, the report indicates the trend of business in the industry as a whole. Issued about the fifth of the month for the preceding month, the report contains comparative data on monthly sales and cumulative totals for the three preceding years.

For the past ten years the Association has compiled statistics and issued a monthly report on production, shipments, and stocks on hand of superphosphate, the most important of the fertilizer materials. This has been made possible through the cooperation of a large number of producers who report their statistics to the Association.

Monthly data on exports and imports of fertilizer and fertilizer materials

are issued in a special report in order to inform members of the industry as to the volume and movement of foreign trade.

An annual report is prepared showing fertilizer consumption for the entire country and for each of the 48 states. This is the only report compiled on fertilizer consumption in the United States as a whole. These data are available from 1910 through 1935.

From time to time the results of research in fertilizer economics appear in the *Price Index Service Letter*, *The N.F.A. News*, and *The Fertilizer Review*. Constant study is given to trends in farm income and prices and their effect on fertilizer sales.

The statistical work is carred on under the supervision of Herbert Willett, statistician and economist of the Association.

CHARLES J. BRAND
Executive Secretary and Treasurer

STATISTICAL PROBABILITY

In recent discussions on probability theory—as, for example, in Professor Nagel's paper in this JOURNAL[1]—the increasing acceptance of frequency as the experimental basis of probability will be regarded with satisfaction by almost all statisticians and physicists. It is impossible, as Dr. Margenau pointed out in his remarks following that paper, to restrict the use of the word "probability" to its technical sense; but we should always be ready to recognize when people are, and when they are not, doing so.

It was to stress the distinction between scientific and non-scientific probabilities that some time ago[2] I stressed that only the former should rightly be referred to as "chances," in the sense that, in contrast to the subjective nature of "degrees of belief," they refer to a supposed external system of causes which are giving rise to our observed frequencies. If it is accepted that our scientific use of probability is to refer only to statistical probability or chance, the remaining problem seems to lie in providing a logical relationship between probability and frequency.

For the pure mathematician there is no difficulty. The validity of the axioms on which probability theory rests do not concern him. From the laws of probability he deduces "expected" frequency averages and fluctuations, in particular showing (with a somewhat extended notion of his usual idea of a limit) that the limit of the theoretical relative frequency is the value of the probability. It is the relationship of this mathematical theory to *actual* frequencies which is of concern to scientists, and which needs to be made clear. Briefly, I would explain it as follows: that from observed frequencies we *infer* probabilities, or in other words, that probability is a *theory* of observed frequency.

From this point of view, probability is similar to other useful scientific concepts. If it is asked: "Is it correct to define probability in terms of fre-

[1] 31 (1936), 10–26.
[2] *Proc. Roy. Soc.* A. 141 (1933), 518–534.

quency?" I would first of all make sure what exactly is meant by a definition. If we recognize that in modern science a definition does not pretend to tell us what something is, but only how we are to set about measuring it, then I would agree that the frequency definition is legitimate. At the same time, we should realise that this definition is based on the laws of probability; this should not be regarded as a drawback, for until we have a probability theory, it is meaningless to talk about a probability in any scientific sense.

This attitude, which is as far as I am aware the accepted one for physical concepts, such as mass and temperature, seems to dispose of criticisms levelled at the frequency approach. It was suggested by Dr. Margenau that the frequency definition be supplemented by the statement that the limit should be insensitive to rearrangement of the ordered sequence by a preassigned rule, in order to avoid such phenomena as regularly alternate heads and tails in coin-tossing being ascribed to chance. From the point of view adopted here, however, this is not necessary, for we are not asserting that we can always say when a probability exists, but merely, if we assume it to exist, how we should attempt to measure it. (Our definition supposes of course that the order of the original sequence is preserved, analogously to the limit of a conditionally convergent series.) Such properties as the invariance of the limit to "blind" selection are, however, useful to us when we are trying to decide whether the observed occurrence of an event appears sufficiently random to be compatible with the probability idea.

To many people this approach may seem too empirical, but it is not more so than is logically necessary. Any theory can only be upheld or discarded in the light of experience; and moreover, as experience accumulates, the extent to which the theory is applicable in different problems becomes known. The question whether the statistical probability or chance can be said to exist, or is always merely a convenient approximation or assumption, is irrelevant for its practical use, though it may afford some interesting speculation. Here I would agree with a remark by Jeffreys[3] that the notion of chance may never be exactly realised in practice. This he amplifies later as follows:

> In the throw of an unbiassed dice, for instance, the probability of a 6 is one-sixth on the supposition that the laws of dynamics hold, and that the probability of the rotation during flight is uniformly distributed over a wide range. The latter assumption is an approximation. In the kinetic theory of gases the estimated time needed to establish an approximately Maxwellian distribution depends on the supposition that the molecules do not begin in such paths that the relative velocities at the first collision are in the line of centres; small deviations in the direction of the initial velocities are required to make the theory work, and the postulate is that within these ranges the probability of the directions is uniformly distributed. This is an approximation of the same character as for dice. The same may be true of the probabilities in wave mechanics.

Similarly in the genetical phenomena of linkage and crossing-over, it is unlikely, apart from well-known sex differences, that the assumption of an

[3] *Proc. Roy. Soc.* A. 146 (1934), 9–16.

exact value for the chance of crossing-over, given a constant external environment, is valid—this chance of crossing-over will depend to a slight extent on the particular complex of genes the chromosomes are carrying. Nevertheless, the assumption is sufficiently accurate for inferences to be made from experimental observations that this "chance" is sometimes appreciably affected by change of external conditions such as rise in temperature.

The practical value of probability will depend in any instance on the value of the approximation or assumption made. All statisticians are aware of a continuous passage from situations in which probability appears to hold exactly, such as in radio-active disintegration in physics, or in biological experimentation where it has been *made to hold* by appropriate randomization, to those where the value of using probability becomes highly questionable, as, for example, with certain types of economic time-series.

In one sense all our statistical probabilities can be regarded simply as mathematical fictions; but that should hardly be accepted as a criticism, for if it were, few, if any, of the familiar concepts of science would be left to us. Our probabilities may be said to exist objectively in the usual and necessary sense—that they are theoretically measurable, and sufficiently well substantiated by experiment.

M. S. BARTLETT, *Statistician*

Imperial Chemical Industries, Limited,
Jealott's Hill Research Station,
Bracknell, Berkshire, England

NOTE ON AN INDEX OF BOND PRICES

Three methods currently used to construct an index of bond prices might be described briefly as follows:

Method I. An index of bond prices derived by taking the arithmetic average of the prices of a selected group of bonds. For example, this method is used by *The Annalist*, the New York Stock Exchange, and *The Financial Post*, Canada.

Method II. An index of bond prices derived by taking a typical standard bond of fixed coupon rate and fixed term to maturity, and finding the price of this standard bond which would correspond to the average yield of the bonds used. Standard Statistics[1] and Moody's Investment Service[2] use this method.

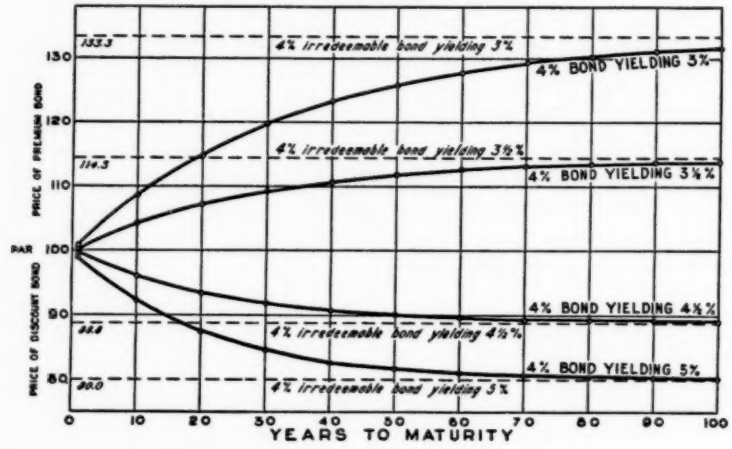
Method III. An index of bond prices derived by capitalizing a selected fixed annual income at the rate of interest given by the average yield of the bonds utilized. This type of index is used by Persons in *Forecasting Business Cycles*,[3] Dow, Jones, and Co.,[4] and the Dominion Bureau of Statistics, Canada.[5]

[1] e.g., Annual Supplement *Survey of Current Business*, U.S. Dept. Com., 1932, p. 291.
[2] e.g., in *Commercial and Financial Chronicle*.
[3] e.g., pp. 93–107, 113–127, 134–148, 157–167; column 8.
[4] e.g., Annual Supplement *Survey of Current Business*, *Ibid.*
[5] e.g., *Monthly Review of Business Statistics*, Jan., 1936, p. 15; Oct., 1935, pp. 6, 10, 30.

In this note we wish to draw attention to the precise meaning and consequent limitation of a bond price index which is obtained by method III, which, for brevity we might term the "capitalization method."

The construction of a series of index numbers for the average prices of a selected group of bonds by the capitalization method might be described as follows: The base figure 100 is the capitalized value (=100) of an income of \$4.00[6] per annum at a rate of 4 per cent. The index number for the average price of these bonds at any date is then obtained by capitalizing the same income of \$4.00 at the rate of the average yield of the bonds for that date;[7]

CHART I



symbolically, $I = 4.00/i$, I being the index number corresponding to yield rate i. Thus, each index number is nothing more nor less than the price of an irredeemable 4 per cent bond bought at a yield rate equal to the average yield of the bonds utilized, for the average of the yields to maturity of the several bonds is treated merely as current yield.[8]

Although this index is mathematically correct only for irredeemable or perpetual bonds such as British Consols, French *rentes*, et cetera, it does serve as a sufficiently approximate measure of the trend in bond prices for bonds whose maturity dates are so far distant that the influence of redemption upon their prices is negligible. For example, the ten railroad bonds used by Persons have on the average fifty or more years to run, and this type of index applied to them furnishes a close approximation to the trend in the actual average prices of these bonds.

Without attempting here to describe the intricate details of bond price computations,[9] it may be readily verified that, for any given yield, the longer

[6] Any other fixed amount could be used.

[7] Persons (*ibid.*, p. 90, or *Review of Economic Statistics*, vol. VIII, no. 1, p. 41) expresses this as capitalizing the yields at 4 per cent, but this is not in accord with the accepted mathematical definition of capitalization; e.g., see E. B. Skinner, *Mathematical Theory of Investment*, p. 283.

[8] See Moore, J. H., *Handbook of Financial Mathematics*, p. 487.

[9] *Ibid.*, pp. 376–577.

the term a bond has to run, the more closely does its price approximate to that of an irredeemable bond having the same coupon rate and the same yield; or, what is the same thing, the shorter the term a bond has to run, the further does its price recede from that of the corresponding irredeemable bond. In view of this relationship, we could scarcely expect this index to give sufficiently close approximations to the actual price movement of short and medium term bonds, and, for such bonds, indices computed by methods I or II would be better.

Some idea of the extent to which this capitalization method is inadequate can be gathered from the accompanying chart which serves to show how the price of a 4 per cent bond bought at the given yields of 5 per cent, 4½ per cent, 3½ per cent, and 3 per cent changes with the term to maturity. The influence of maturity alone upon the price is of comparatively little consequence when the bond is far removed from the maturity date. Thus, at a yield of 5 per cent, the price rise between the 60- and 50-year terms to run is about $0.66 (from approximately 81.03 to 81.69), while the rise between the 30- to 20-year terms to run is about $2.90 (approximately 84.55 to 87.45). Technically expressed, the price curve for any given yield does not slope uniformly, tending rather to converge more slowly with increasing maturity—the price of the corresponding irredeemable bond being the asymptotic limit (an upper limit in the case of a premium bond, a lower limit for the discount bond).

As a concrete illustration of the inapplicability of this index to bonds which are not very long term bonds, we cite the following results for a group of six Dominion Canada Government bonds of various maturities. The approximate asked prices and yields for these bonds on two given dates are:[10]

		Dec. 2, 1933		Dec. 1, 1934	
Rate	Due	Price	Yield	Price	Yield
4½	1949–59	99.50	4.60	109.25	3.69
4½	1948–58	98.65	4.60	109.15	3.66
4	1947–52	94.50	4.43	104.65	3.55
4½	1946	100.00	4.50	109.15	3.51
4½	1944	100.00	4.50	109.15	3.40
5	1943	102.75	4.65	112.50	3.36
Average		99.23	4.55	108.98	3.53

The index numbers for the average prices on Dec. 2, 1933, and Dec. 1, 1934, from the formula[11] are 87.9 and 113.3 respectively. Clearly, these figures are an extremely inaccurate representation of the actual change in the average price of this group of bonds, since they indicate a price change from 1933 to 1934 of about 28.9 per cent, while the approximate actual change was only about 9.8 per cent.

It appears to be obvious that this index cannot be regarded as a sensible

[10] Data from A. E. Ames and Co.
[11] Fixed amount capitalized assumed to be $4.00.

indicator of the actual price changes for short or medium term bonds, and should not be used for bonds of this class. When the bonds utilized have very distant maturities, however, the index does give a close approximation to the actual prices, and may be regarded as a reliable index of the bond price trend for such bonds.

So far as the writer is aware, no mention of this maturity requirement is made by Persons or other references consulted, and, consequently, the index may be credited with more general application as a bond price index than it merits.

In conclusion, we might remark upon the advisability of using the trend in bond yields as a more significant indicator of comparable bond value in many cases. The Babsonchart of Business Conditions, for instance, traces the variations in the average yield of 60 active bonds. These yields are plotted on an inverted scale, giving the yield trend an apparent direction similar to that of the price trend. *The Annalist* plots the average yields of ten railroad bonds in this same way, showing the yield trend on the same chart as the bond price trend (computed by method I) for these bonds. Briefly, indices of bond yields would seem to present a very useful measure of bond value comparisons for many purposes.

A. WILLARD TURNER

Ottawa, Canada

PROGRESS OF WORK IN THE CENSUS BUREAU

The 74th Congress adjourned without having made any provision for a compilation of accident statistics, such as that which was described in the December issue of the JOURNAL. Neither did it pass the Joint Resolution, introduced about 5 days before the adjournment, providing for a census of employment and population to be taken some time within the next ten months under the provisions of the Act of 1929 providing for the Fifteenth and subsequent decennial censuses.

THE PRINTING SITUATION

The Bureau of the Census in recent years has experienced great difficulty in obtaining sufficient funds to provide for printing its reports. As a result reports have been delayed and to some extent curtailed; the editions have been reduced; and it has happened more than once that completed reports have to be carried over to be printed out of the allotment for the next year. Because of such a carry-over from the preceding year the printing allotment of $82,000 for the fiscal year 1935–36 was exhausted early in January, which meant that a number of important reports would have to wait until the 1st of July 1936 before they could be forwarded for printing. Among these were the 1934 reports on Mortality, Births, Financial Statistics of Cities, Prisoners, and Mental Patients. This situation was brought forcibly to the attention of the House Committee on Appropriations by a memorandum prepared in the Census Bureau and submitted at the hearings last

February. The Committee in response to this appeal set apart from the general appropriation the sum of $35,000 to be immediately available for printing the delayed reports. This sum did not, of course, actually become available until the Appropriation Act was passed on May 15th. The reports are now being prepared for offset printing, as the sum was not sufficient to cover the cost of printing from type.

The printed record of the hearings before the Committee include the memorandum submitted by the Bureau and also the resolutions relative to Census printing adopted by the Census Advisory Committee at its meeting last November; and in its report the House Committee went on record in favor of the principle for which the Bureau has always contended, namely that provisions for printing the results of any census or statistical inquiry should be included with the appropriation for collecting and tabulating the data, instead of depending upon an allotment from a general printing appropriation made for a later year after the tabulations have been completed.

LIFE TABLES

The Bureau has for some time had in preparation a set of life tables making use of the results of the census of 1930. Tables for white males, white females, Negro males, and Negro females, based on population in 1930 and deaths from 1929 to 1931, were published in a recent issue of *Special Reports —Vital Statistics*. These and the other tables that have been prepared will be included in the volume which is to be issued later.

This is the first time that it has been possible to prepare life tables covering all continental United States. The Glover Tables, which were prepared in the Census Bureau in the period following the census of 1910, were necessarily limited to the original registration states. After the census of 1920 abridged life tables were prepared covering the registration states of 1920.

In order to compare conditions at the present time with those of an earlier period one needs to have tables covering the same territory. To meet that need the Bureau is preparing three sets of tables covering the registration states of 1920, one set based on population in 1930 and deaths 1929 to 1931, another on population in 1920 and 1930 and deaths 1921 to 1929, and a third on population in 1920 and deaths 1919 to 1921. These will be complete tables giving data by single years of age for whites and Negroes of each sex. Heretofore the only life tables available for 1920 have been the abridged tables mentioned above. Then there will be tables covering the original registration states but based on the population in 1930 and deaths 1929 to 1931. These tables will make it possible to study the changes that took place in the expectation of life and in other life table functions during the period 1900 to 1930.

CENSUS OF BUSINESS

The field canvass for the 1935 census of business is completed. The first series of retail tables have been published for certain states giving number of stores, sales, employment and pay roll by kinds of business. These tables

will be followed by detailed state reports showing by counties, cities, and towns the full range of statistical data similar to the state reports for previous censuses. They will include commodity sales tables, such as were shown in the 1929 census of distribution but were omitted in 1933. Wholesale reports will be ready for some States in October.

Because of the variety of subjects covered, the Bureau has provided a two-page check list containing brief descriptions of each series of reports, on which those persons requesting publications are asked to indicate exactly what reports are wanted and for what States or cities. Copies of the check list may be had on application to the Bureau of the Census at Washington or at Philadelphia, and are returnable to the Philadelphia office from which all publications will be distributed.

J. A. H.

GRAPHIC PRESENTATION

Some of our readers will recall that back in 1914 the American Statistical Association joined with sixteen other interested organizations to form a joint committee on Standards for Graphic Presentation. In fact, our representative, Mr. L. P. Ayres, became secretary of the committee. The following year this joint committee published a report which defined certain terms employed in graphical presentation and set up certain standards of practice for the construction of graphs and charts.[1] This report is still valuable as a guide.

In 1926 at the request of The American Society of Mechanical Engineers the American Standards Association authorized the organization of a national technical committee to make an intensive study of this subject in its various aspects and to prepare a series of standard practices which will eventually become American Standards. This Sectional Committee on Standards for Graphic Presentation was organized in November 1926 and is now headed by Mr. Willard Chevalier, Vice-President, McGraw-Hill Publishing Company, as chairman. Shortly after its organization it formed subcommittees on "Time Series Charts" and "Engineering and Scientific Graphs." Mr. A. H. Richardson has served as chairman of the first and Dr. W. A. Shewhart has served as chairman of the second. This sectional committee now consists of official representatives of 25 national organizations of which the American Statistical Association is one, with the A.S.M.E. as the sponsor body.

The Subcommittee on Time Series Charts completed the first tentative draft of its report last April. This is now available in pamphlet form.[2] In its present form this code has been limited almost entirely to line charts but column and surface forms of time series charts are discussed in the appendix. As good graphic presentation does not depend on a single broad decision but on a considerable number of detailed decisions, the code is necessarily

[1] This JOURNAL vol. 14, 1915, pp. 790–8.

[2] Copies may be secured from the Publication-Sales Department, ASME, 29 West 39th Street, New York, N. Y., Price $1.00.

made up of a rather detailed discussion of specific points. Some of these may not in themselves seem important, but collectively, it is the decisions on such minor points which determine the success or failure of a chart.

The committee has worked on the principle that flexibility rather than standardization must be the keynote in any successful code of preferred practice. The chart must be prepared in the light of the characteristics of the data at hand, and the use to which the chart is to be put, but such individual treatment, to be effective, must not do violence to the fundamental principles of graphic presentation.

The Subcommittee on Engineering and Scientific Graphs completed and published in November 1932 what was in effect a tentative draft of its more complete report. This covered the construction of graphs with special reference to their use as lantern slides. The subcommittee has kept, however, steadily at work on its complete report through the activities of a subgroup, Mr. H. F. Dodge, chairman, and expects to make it available in tentative draft form early in the fall. This proposed American Standard which will cover recommended practices for the presentation in a plane of the functional relationship between two variables is intended for the guidance of authors, editors, and draftsmen who are preparing graphs for reproduction in scientific and technical publications.

LETTERS TO THE EDITORS

Mr. F. E. Andrews, author of *New Numbers*, which was reviewed in the June, 1936, issue of this JOURNAL, makes the following comment, in a letter to the Review Editor, on Mr. Lovitt's review:

> In one paragraph of his review Mr. Lovitt charges that "the book is crowded with bald assertions for which no proof is attempted. For example, p. 49: 'An examination of 6 reveals real possibilities. It is at least far better than our present number base.' " Now page 49 does include the assertion Mr. Lovitt quotes, and immediately following it are given three reasons for the superiority of 6 as a number base, and one limitation against it. In brief, the reviewer truncates the supporting evidence from his quotation, and then condemns the book for the alleged absence of the material *he* has cut out.
>
> In another paragraph Mr. Lovitt challenges the accuracy of the book. Now I should be amazed if a book with as many computations as this one failed to include some errors. But many mathematicians have now been over it, and no error has yet been called to my attention. The two Mr. Lovitt finds happen to be due to his own inability to add.
>
> The question is the number of products ending in zero in the complete multiplication tables of the two number systems. "Complete multiplication table" is further defined as "multiplying the first twelve quantities by each of the first twelve quantities."
>
> Here is a simple question of fact which, at least for the ten base, a sixth-grade schoolboy could solve. Twelve products ending in zero are found in the 10-line table; six in the 5-line table; two each in the 2, 4, 6, 8, and 12-line tables; one each in the 1, 3, 7, 9, and 11-line tables. Total, 33. Mr. Lovitt thinks there are only 32. He concludes it must be the book which is inaccurate.

Mr. Lovitt has submitted the following reply:

Mr. Andrews is correct in his statement on p. 58 that "in the system of 10, 33 of the totals end in zero."

In a letter to the Editor of the JOURNAL protesting Professor David McCahan's review of *Insurance and Annuities from the Buyer's Point of View*, in the March, 1936, issue of this JOURNAL, Mr. E. C. Harwood, one of the authors of the volume, makes the following comment:

> There are a number of inaccuracies in the review which I will not touch upon . . . . It does seem advisable, however, to point out that Mr. McCahan has either greatly exaggerated, or that he has important information not available to the general public. He asserts that our ratings of the companies and cost comparisons are " . . . dangerously misleading to the reader who acts on them." I feel that this is a matter of grave importance, and that Mr. McCahan should have boldly indicated which of the rated policies would prove "dangerous" to the reader who selects them.

Professor McCahan in his reply says:

> Mr. Harwood is very evidently begging the entire question . . . . I did not say that any of the "rated policies" would prove dangerous, but rather that his method of rating them and that his suggestion of dropping the insurance in one company and taking it out in another on the basis of a superficial, and wholly unscientific rating plan, may be "dangerously misleading to the reader who acts on them."

A CORRECTION

In the paper by Samuel A. Stouffer, this JOURNAL, vol. 31, (June, 1936), p. 352, the sentence containing equation (3d) should be corrected to read: "As a consequence of the operation in passing from (3b) to (3c), any $(s-1)$-rowed minor of Δ,

$$\Delta_{ij} = \frac{\sqrt{d_{ii}d_{jj}}}{d_{11}d_{22}\cdots d_{ss}}\Delta'_{ij},\text{" }\cdots$$

CHAPTER ACTIVITIES

THE ALBANY CHAPTER.—The annual meeting of the Albany Chapter was held May 18, 1936, at the Candle Light Inn in Albany. Dr. Warren W. Coxe, President of the Chapter, presided. The Secretary reported that there had been five meetings and one picnic during the preceding year with an aggregate attendance of 145 members and guests. He also reported that there were 39 members in the Chapter and that there was a comfortable balance in the treasury. The following officers were elected for the ensuing year: Dr. Warren W. Coxe, Director of Research, State Education Department, President; Miss Elizabeth Parkhurst, Senior Statistician, State Department of Health, Vice-President; Dr. R. F. Bucknam, Associate Rates Examiner, Public Service Commission of New York, Secretary-Treasurer; and Messrs. C. M. Armstrong, General Electric Company, and E. H. Van Winkle, Professor of Business Statistics, Rensselaer Polytechnic Institute, members of the Executive Committee.

Dr. Joseph S. Davis, President of the American Statistical Association, spoke on "The Art of Statistical Exposition." He explained that he wished to include not merely the presentation of statistical data in tables and charts, but all of the phases involved in setting forth, in written or oral form, analyses and interpretations involving statistical data. He explained further that he wished to speak not as a master of this art but as one who has been struggling for years to learn how to speak and write clearly, interestingly, and effectively, with special reference to subjects that involve statistical materials.

Statistics may be regarded as an addition to the language which may be used cleverly or clumsily, carelessly or skilfully. The art of using statistics interestingly and effectively has been unduly neglected, and is worthy of study and cultivation. Masters of this art are few, and the general level of our current performance is far below reasonably attainable standards.

In some quarters there has been for many years an urge to set up standards for statistical presentation—in particular, rules for graphic representation and table construction. Some of those developed are good, some are bad; but generally they have the vice of tending to be restrictive, straitjacketing. Another line of attack might be favored. It involves, first, the enunciation of significant broad principles that can be applied with flexibility and individual variations in almost all situations; and, second, the collection of a large number of examples to illustrate good, bad, and indifferent modes of application.

Since very little attention has been focussed on *principles*, Dr. Davis presented a number of them briefly. As basic principles he suggested the following: *Consider your readers (or hearers)*. Unless one has clearly in mind the group for whom he is preparing tables, charts, and statistical discussions, he cannot safely expect them to understand and like what he presents. What is appropriate in a paper to be read in print is often inappropriate in an oral

address; in the latter, greater simplicity in almost every detail is usually essential. *Be earnestly considerate of your readers (or hearers).* Deal with them in such a way as not to overstrain their capacities or needlessly wound their sensibilities. *Let the purpose of the presentation dominate the details of its exposition.* Many questions can be settled better by considering the purpose of the presentation and the convenience of the reader than by any uniform rule. The discussion was developed further in terms of eight subsidiary and related principles expressed in more specific terms.

General discussion on the subject followed the talk by Dr. Davis and at the conclusion of this discussion he was given a rising vote of thanks. There was then an informal discussion about programs for the ensuing year. It was generally agreed that some of the subjects should be of a technical character and others of a more general interest. Dr. Davis was asked for his advice. He brought out that the Statistical Association is not and never has been exclusively an association of statisticians. Membership is open to those seriously interested in statistics. He suggested that the character of chapter programs had more bearing on the make-up of the group who attended than on the number in attendance. He described the experience of the San Francisco Chapter, in which almost none of the meetings are concerned with mathematical statistics, and several programs fall outside the statistical field. He expressed the opinion that meetings for discussion of topics with significant statistical aspects drew about as large attendance as meetings having no particular relation to statistics.

THE AUSTIN CHAPTER.—The Austin Chapter held its third meeting of the year on April 30, 1936, in the Union Building on the campus of The University of Texas. The principal speaker was Dr. John R. Stockton, formerly Chief of the Bureau of Marketing Research of the Meredith Publishing Company, now Assistant Professor of Business Administration at The University of Texas. Dr. Stockton spoke on the "Use of Statistics by a Magazine Publisher." Twenty-nine members and guests were present at the meeting. A number engaged in round table discussion of the paper at the conclusion of Dr. Stockton's address. Officers for the ensuing year were re-elected as follows: Dr. F. A. Buechel, Director of the Bureau of Business Research, University of Texas, President; Mr. F. E. Finely of the United States Bureau of Agricultural Economics, Vice-President; and Mr. C. D. Simmons, Professor of Business Statistics and Investment Officer of The University of Texas, Secretary.

THE CHICAGO CHAPTER.—The annual meeting of the Chapter was held on May 6, 1936, bringing to a close a most successful year. During the past year, the Chapter held six dinner meetings, with an average attendance of 55, and had a membership of 107 as against 73 the previous year. Officers elected for the coming year are as follows: President, Harland H. Allen, Editor of the Harland Allen Economic Letters; Vice-President, John H. Noble of Armour & Co.; and Directors, John W. Boatwright, Statistician,

Standard Oil Company of Indiana; H. B. Stair, Statistician, Illinois Bell Telephone Co.; and Theodore O. Yntema, Professor of Statistics, University of Chicago.

Following the business meeting, the Chapter heard two very interesting addresses. The first speaker was Harris G. Pett, Manager, Division of Research and Statistics, Federal Reserve Bank of Chicago, who spoke on "Keeping Up With Business Conditions." He was followed by Roderick P. Stewart, Chief editorial representative of the *Wall Street Journal* in Chicago, who discussed "Keeping Up With the Corporations."

THE CLEVELAND CHAPTER.—The fifth meeting of the Business Statistics Section of the Cleveland Chapter was held on Monday, March 16. The group made it semi-annual forecast of the Federal Reserve index of industrial production. The arithmetic mean of the individual forecasts for the 12 months ending with January, 1937, was 12 per cent above the actual for the 12 months ending with January, 1936. The percentage improvement estimated by the individual members ranged from 7 per cent to 18 per cent. The next meeting of the Business Statistics Section will take place in September.

The annual meeting of the Cleveland Chapter was held on Monday evening, May 11, in the Cleveland Chamber of Commerce Club. Theodore H. Smith, Professor of Marketing at Fenn College, made an informative and interesting address on the subject of "Consumer Cooperatives." Col. Leonard P. Ayres, Vice-President of The Cleveland Trust Company, spoke on "Inflation and Its Timing." Col. Ayres summarized the contents of the most recent pamphlet issued by The Cleveland Trust Company, "Inflation." Mr. L. M. Whittington of the Van Sweringen Company was chosen as President of the Chapter for the ensuing year and Dr. Frank T. Carlton of Case School of Applied Science, as Vice-President.

THE CONNECTICUT CHAPTER.—The Regular and Business Sections of the Connecticut Chapter met on April 23, 1936, for an open forum discussion of "The Present Business Trend, Will It Continue?" and "The Effect of Continued Unemployment and Heavy Federal Expenditures." On May 26, Dr. F. K. Shuttleworth of the Yale Institute of Human Relations spoke on "Sexual Maturation and Growth of Girls." The Chapter discussed plans for the next academic year, particularly on the possible inclusion of subjects dealing with vital statistics and demography in general and with respect to the choice of business and economic subjects for coming meetings.

THE NEW YORK DISTRICT CHAPTER.—At a dinner meeting of the New York District Chapter of the American Statistical Association held on May 21, 1936, the general topic was "The Future of Interest Rates." The presiding officer was Mr. F. R. Macaulay of Bernstein-Macaulay.

The first speaker, Colonel Allen M. Pope, spoke on the subject, "The Bond Market as Affected by the Trend in Interest Rates." He believed that the change in our present low yield on Government investments can

come from five general causes, namely: (1) increased use of funds for capital improvements, (2) increased use of funds for current needs of industry, (3) investment of capital abroad or flights of capital abroad, (4) waste or destruction of capital, such as the result of a war, and (5) artificial tampering with natural economic laws. The first three causes do not seem likely to produce any significant effects very soon. Little tightening of money rates in this country would be produced by a European war in which we were strictly neutral. Changes in money rates because of artificial tampering with natural economic laws are by far the most likely. Attention was called specifically to the probable results from the Social Security Act, possible changes in Reserve requirements, sale of Government securities held by the Reserve System, and the continued increase in Government debt. Mr. Pope's conclusions were that in the near future the danger of a change in the trend of money rates upward comes, if at all, from the acts of our own Government, which already has it in its power to produce such changes. For a long time the buying power for new Government securities can be maintained, but a point may be reached when it is too dangerous to go further in increasing our debt, namely, when the resulting excessive taxation will actually diminish the aggregate wealth of the country.

Mr. L. R. Robinson spoke on the subject, "Interest Rates and Commodity Prices." Whether price changes are analyzed from the standpoint of the business cycle or from the standpoint of purely monetary or credit factors, a close relationship is found between the movements of commodity prices and the movements of long-term, high-grade bond yields, and this logical relationship stands out over the longer term in the recorded trends. In only one of the last five years, however, have bond yields and prices moved together. During the next two or three years, Mr. Robinson expects a considerable rise in the level of prices, with an increase in interest rates generally. In comment on Mr. Robinson's paper, the presiding officer questioned the closeness of the parallelism between British Consols and commodity prices. He called attention to the desirability of considering associated circumstances, such as the changes in the physical volume of business, the fears that the rise will get out of hand, and the like.

Professor B. H. Beckhart of Columbia University spoke on "The Future of Interest Rates and the Money Market." While admitting that in the long run, short-term rates of interest will rise because they obviously cannot decline further, he discussed the question of how long these rates will remain at these present levels and when a rise may be expected. He emphasized the peculiar relation of the U. S. Treasury Department to the money market. The Treasury desires to continue to float its obligations at the lowest possible rate of interest and in some respects has usurped the central banking functions of the Federal Reserve Banks as one of the consequences flowing from the devaluation of the gold dollar and from silver purchases. Through Treasury control therefore, short-term rates will continue at low levels for several years. There are, to be sure, various factors which might tend toward a reduction in excess reserves, namely: (1) gold exports, (2) an increase in

currency, (3) increases in deposit totals, (4) administrative action, such as reclassification of cities as Reserve and Central Reserve cities, and (5) reduction of the security portfolio of the Federal Reserve Banks. Factors which might tend toward an increase in Member Bank reserves include further, gold imports, use of profits of gold devaluation, and silver purchases and revaluation. Weighing these factors, the chances are that excess reserves may actually be increased during the next two or three years. Low money rates will continue until excess reserves are eliminated or absorbed or until a sharp increase in commodity prices occurs. From a broad economic point of view, the low money market rates of interest now prevailing are highly dangerous in that they will stimulate a rapid expansion in private debt and the production of capital goods and that the income from capital goods will be capitalized at artificially low rates. The next crisis will probably be characterized, therefore, by a drastic readjustment in capital values resulting from the ultimately inevitable rise in interest rates.

The last scheduled speaker was Dr. Lionel D. Edie on the subject, "Long-Term Interest Rates." Dr. Edie emphasized the change in the financial point of view, as a result of which banks are not only buying longer term Governments but are enthusiastic about it. He believed that the only place where we now have a wild inflation is in the high grade bond market, which is inflated relatively more than the stock market was in 1929 and is just as vulnerable. It was his guess that the low for money rates and the peak of bond prices will prove to be the middle of 1936 plus or minus twelve months. He believes that other speakers have exaggerated the influence of excess reserves on the outlook for bond prices and also have put too much stress upon the ability of the Government to dominate bond prices and the level of money rates. He stressed, on the other hand, the growth of normal demand for capital growing out of the restoration of confidence and business recovery.

In discussion, the presiding officer expressed the opinion that we will not have any of that type of violent currency inflation that leads to panicky fear and that, under certain circumstances, we are likely to enter one of the greatest booms this country has ever seen affecting commodity prices, business, building, and the stock market. The result would, of course, be at least some reduction in bond prices. Dr. W. R. Burgess, of the New York Federal Reserve Bank, pointed out that Mr. Robinson and Mr. Edie had approached the problem through the analysis of the trends and the swings of the cycle, while Colonel Pope and Professor Beckhart had made use of a sort of accounting analysis of the money position. If you approach the problem from the latter point of view, the outstanding feature is the uniqueness of the whole present situation. Mr. J. F. Hughes expressed the view that in spite of the tremendous demand for new capital, the philosophy of the new era of high stock prices was not disturbed until the Federal Reserve Board decided they had run too far. It would seem possible to have a moderate increase of capital demand, yet for a number of years have a new era of high bond prices along with it.

THE PHILADELPHIA CHAPTER.—The Philadelphia Chapter of the American Statistical Association discussed "Building and Business Revival" at a dinner meeting on April 24, 1936.

Mr. David T. Rowlands of the Wharton School of the University of Pennsylvania discussed the general question of the building industry and business activity. He pointed out that the volume of building fluctuates much more widely than building costs, and indicated that building volume is not closely related to building costs. The current situation in building was analyzed and the significance of fluctuations in the volume of building activity to investors in real estate was noted.

Mr. Ernest M. Fisher, Director of the Division of Economics and Statistics of the Federal Housing Administration, analyzed problems in measuring the demand for building. Emphasis was placed upon the very great difficulty in defining the units of measurement and in securing adequate data as to the supply of building of various types. The real property inventory of 64 cities has been extended to cover more than 150 cities. It forms an important beginning of an adequate statistical basis for measuring demand. Further, in regard to residential properties, the difficulty of defining a dwelling unit, of defining, for residential purposes, a family and the difficulty of setting up minimum standards of housing that are universally applicable was stressed. The problem is further complicated by the extraordinary mobility of the population. The building industry is relatively inflexible in comparison with the fluctuations in demand. There are some 30,000,000 dwelling units in the United States and the maximum annual production is 800,000. Thus with such a small increment of change possible the fluctuation of 5 per cent up or down in demand creates a very great dislocation in the entire residential construction field. In the industrial field, measurement of demand is complicated by the migration of industries between different parts of the country and even within the same metropolitan area; also by the rate of obsolescence of industrial equipment regarding which further information is needed. In the commercial field, prosperity brings a large amount of building of monumental structures connected with the desire to perpetuate an individual or corporate name.

Mr. David L. Wickens of the National Bureau of Economic Research discussed real estate financing and economic stability. Pointing out the magnitude of the problem, Mr. Wickens indicated that half of the national wealth is represented by real property and that the real estate total debt is larger than any other type of debt. There are 30,000,000 families in the United States of whom more than half are real estate owners. Thus the volume of credit and the terms of credit have wide economic consequences. Real estate and building operations as usually financed over a period of years require fixed payments each year. The result of this is that as income falls in a community a much larger proportion of the total income must go into fixed charges in the real estate field. This has obviously unfortunate consequences. The condition is greatly aggravated as income is further curtailed. The greatest weakness of this financing plan is its inflexibility. The financing which is

taking place today in the real estate field is in this respect usually similar to that involved before the depression and which greatly aggravated it. Mr. Wickens indicated that a new type of credit instrument in the real estate field is greatly needed. Such an instrument would vary the annual payments with the level of income within the community. It was emphasized that this did not involve a variable interest rate, rather the cutting down during the depression period of the amount of fixed charges payable in those years and the proportionate or compensating increase in fixed charges during normal and prosperous periods.

"Social Security, the problem of insecurity and how to meet it" was the subject of the final chapter meeting of the year held on May 26th. The first paper was by Mr. Hugh Carter, Department of Sociology, Wharton School, University of Pennsylvania, who made an analysis of relief trends since 1900 for their bearing on social security. He stressed the accelerating rise in the burden of relief during the past 35 years and the impossibility of meeting the problem through private charity or local effort. He referred to studies of relief chiseling that indicated, contrary to popular belief, that very little public assistance was given to those not entitled to it. Mr. Carter emphasized the need for a comprehensive social security program integrated with an adequate public assistance program.

Mr. Ewan Clague, Assistant Director of Research and Statistics of the Social Security Board, analyzed the main provisions of the Federal Social Security Act of 1935. In discussing the old age provisions of the Act he pointed out that the age distribution of the population of the United States is rapidly changing due to the declining birth rate and this will give a seriously over-aged population. This abnormally large proportion of the aged will become more pronounced during the next two or three decades. The problems of administration connected with unemployment insurance were analyzed by Mr. Clague. He pointed out that a nation-wide system of unemployment insurance rather than entirely distinct systems in each of the forty-eight states as provided by the present Act would be simpler to administer. He indicated that the problems connected with migratory labor were being carefully studied with a view to working out a feasible system of unemployment reserves. Should pronounced localism develop, a serious problem will be created for the workers who move from state to state and for those workers who live in one state and work in another. The various grants in aid involving mothers assistance, aid to crippled children and others were described by the speaker.

Mr. Cyril James of the Department of Economics of the University of Pennsylvania analyzed financial aspects of the Social Security Act. In his view, the obligation of providing minimum economic security for the entire population is not open to question. From a financial standpoint it would appear to be preferable and much simpler to raise the necessary revenues for unemployment reserves, old age pensions and other necessary payments through increased income taxes, graduated downward to include the lowest income classes rather than through payroll taxes as is involved in the Social

Security Act. Professor James also questioned the wisdom of piling up reserves during years of prosperity and paying them out during years of depression. Such piling up of reserves invested in Federal securities would ease the money market and tend to lower interest rates during periods of prosperity when this is undesirable. Contracting of the reserves during periods of depression would have the opposite effect which is equally undesirable.

Mr. Frederick Stephan, Secretary of the American Statistical Association, discussed the work and purposes of the Association.

At the annual business meeting, the Chapter re-elected Mr. Casimir Sienkiewicz, Director of Research of the Philadelphia Federal Reserve Bank, as President; Mr. C. Parker Bursk, Department of Statistics, University of Pennsylvania, as Vice-President; and Mr. Hugh Carter, Department of Sociology, University of Pennsylvania, as Secretary.

THE PITTSBURGH CHAPTER.—A meeting of the Chapter held April 23 was addressed by Dr. Emil Lederer, sometime Professor of Political Economy, University of Heidelberg, and Dean, Graduate Faculty of Political and Social Science, New School of Social Research, New York. Dr. Lederer spoke on the subject, "Present Position in our Economic Cycle." Keen interest was evident in the many questions asked of Dr. Lederer when he had finished his address. The next meeting, held on May 28, was addressed by Mr. Mark S. James, Secretary-Manager, Pittsburgh Commission for Industrial Expansion, on the subject, "Why the Pittsburgh Commission for Industrial Expansion Was Formed." The Chapter held two meetings in June, the first in conjunction with the Economic Club of Pittsburgh and The Pittsburgh Personnel Association. This was a dinner meeting, held Thursday evening, June 11, at the Harvard-Yale-Princeton Club. It was a symposium on "Employment Problems under the Social Security Act and Unemployment Compensation Legislature in Pennsylvania." Dr. Francis Tyson, Professor of Economics at the University of Pittsburgh, presided.

The annual election of officers was held at the meeting on June 25. Mr. J. Blair Easter of John A. Beattie and Company was elected President. Mr. William R. Hamilton of West Penn Power Company was elected Vice-President and Mr. Frank M. Kenney of the Duquesne Light Company was nominated as Secretary.

THE SAN FRANCISCO CHAPTER.—"The Measurement of the Cost of Living" was the subject of a meeting of the Chapter on April 21, 1936. The speaker was Dr. Emily H. Huntington, Assistant Professor of Economics at the University of California, and Chairman of the Heller Committee for Research in Social Economics. The following is a summary of Miss Huntington's paper.

The United States Department of Labor, Bureau of Labor Statistics, has recently made certain important changes in its index numbers of the cost of living for wage earners and low salaried workers. The system of weighting has been changed in accordance with a suggestion made in 1931 by Margaret

Hogg. In computing the index numbers as published previous to 1935 the Department of Labor assumed that the distribution of expenditure in 1913, the base period, was the same as in 1917–1919, the year of the Bureau's country-wide cost of living study. This resulted in imputed weights for 1917–1919 which differed from those shown by the cost of living study. The reasons for this difference were the extreme and uneven price changes in the intervening period. In the computation of the corrected index number, the average cost of goods in 1913 equivalent to those purchased in 1917–1919 have been used to determine the weights. The result of this is a different set of weights in 1913 and the true weights for 1917–1919. This involves the assumption that spending habits were the same in 1913 as they were in 1917–1919. While this assumption undoubtedly does some violence to the facts it is certainly an improvement over the earlier method. The next step in the revision of the cost of living index will occur when the results of the consumption study now under way, which will presumably cover the period 1933–1935, are available. New weights can thus be computed based on more recent consumption habits.

The problem of splicing the index with the new weights to the one with the old weights is a difficult one. If 1923–1925 is to be used as the base year the new weights can be used in that year and thereafter, or the change may be allocated over the years from 1919 to 1923. Obviously all the change in consumption habits did not occur in the years 1923–1925, so that it would probably be preferable to compute the index number with the new weights back to 1918, compare it with the index with the old weights and distribute the difference over the period up to 1923–1925. It should be pointed out that there may have been greater changes in consumption habits after 1925 than before, but if 1923–1925 is to be the base period no part of the change in consumption habits can enter into the weights following that date.

Another problem of importance in the making of index numbers of the cost of living is the choice of commodities to be priced. Whether the method is to price sample articles in each category of expenditure as is done by the Bureau of Labor Statistics, or to price all of the items in a standard budget which is the method used by the Heller Committee for Research in Social Economics of the University of California, choices of articles to be included must be made.

A series of problems arise in relation to articles to be priced. Some articles disappear entirely from the stores, others, while still on the shelves, are seldom purchased. Again stores frequently discontinue a commodity of a given price and substitute one of a different quality. Another difficulty to be faced is that of a fixed price policy. Throughout a period of changing prices articles of clothing for instance are frequently sold at the same price. In such cases the quality has undoubtedly been changed. In these situations the same consumers probably substitute the commodity of a different quality for the one previously purchased. To them this means a change in cost of living but it is obviously not a change in the prices of identical commodities.

If the period for which the index number is being computed is short it

may be possible to price the substituted commodity back over previous years and thus secure an index number which measures both changes in prices and in cost of living. The makers of such index numbers, however, are always desirous of measuring changes over a long span of years. It is obviously impossible to compute a fixed base index number which will accurately measure both changes in prices over a long span of years and changes in consumption habits.

Over a span of years such as from 1900–1913, consumption habits may have changed as for instance by the addition of automobiles or radios in families of wage earners. There would be no justification for including the cost of these items for the entire period 1900–1933, nor would there be justification for adding them in any given year and comparing the cost of living with preceding years or even in distributing their cost over a period of years and thus assuming that the addition of an automobile or a radio has brought a gradual rise in the cost of living.

It appears impossible to compute an index number over a long span of years which measures both changes in prices and changes in standards. If the same articles continue to be priced, the resulting figure may be meaningless since the prices of new articles may not move in the direction of those used throughout the entire period. If new articles are added, comparisons of prices cannot be made with the period before the additions were made. Where drastic changes in consumption habits occur, the only way out of the dilemma would appear to be to discard the previous cost of living figures and set up a new base, prior to which the index would not be computed.

THE WASHINGTON STATISTICAL SOCIETY.—The annual meeting of the Washington Statistical Society was held on May 30, 1936, at the Cosmos Club. The Society was honored by the presence of the President of the American Statistical Association, Joseph S. Davis. President Mordecai Ezekiel presided. E. Dana Durand presented a report of the Nominating Committee and the following officers were elected: President, Ewan Clague, Associate Director of the Division of Research and Statistics, Social Security Board, and Vice-President, Spurgeon Bell, Director, Division of Research and Statistics, Home Owners Loan Corporation. Thomas B. Rhodes of the Works Progress Administration was nominated as Secretary.

The subject of the evening's program was "The National Income and What We Know About It." The principal speakers were O. C. Stine of the Bureau of Agricultural Economics; Clark Warburton of the Federal Deposit Insurance Corporation; and R. R. Nathan of the Bureau of Foreign and Domestic Commerce. The discussion was opened by Louis H. Bean of the Agricultural Adjustment Administration. A digest of the principal papers follows:

Mr. Stine: There are too many "national income" figures in circulation, and partly on this account it is too difficult for many to know much if anything about our national income. These national income estimates as a rule have distinguishing labels, but few people understand the significance of the

different descriptions or differences in labels. As a rule, each is an attempt to measure the national income and the difference in description is an indication of difference in approach and may or may not have great significance in indicating the differences in character of results. Some economists and statisticians argue that we need a variety of approaches and a considerable variety of results, and the problem is such that justification can be found for many different approaches and different estimates. The great variety that has developed, however, leads to confusion. The public should have one clearly defined and clearly labeled estimate of national income for common use. Comparable estimates should be provided annually for a period of years sufficient for making the comparisons that are usually wanted, and the annual estimates should be maintained currently and fairly closely up to date.

The subdivision or breakdown of a national income estimate should be in terms that are most significant to the public. The estimates should show from year to year changes in the incomes of large social and industrial groups which are commonly considered in relation to each other, such as agriculture, mining, manufacturing, and railroads, also significant changes in income per person by income-size groups.

This leads me to the point of income comparisons. The first requirement to be met is, of course, historical comparability, and the second most important requirement is to secure a fair degree of comparability among income producers or receivers. The work originally undertaken in the Department of Agriculture was primarily for the purpose of developing a measure of historical changes in the economic position of the farmer that was better than the use of price changes or changes in crop values. The temptation to make comparisons of income received from agriculture with income received from other sources led to the making of some comparisons of changes in wages and payrolls. This brought much criticism, some of which was warranted and some of which went beyond rational considerations.

You are all familiar with the recent developments in the agricultural field involving price and income estimates. To develop the point, let me review briefly the facts. The political struggle for improving the position of agricultural producers in relation to those engaged in other lines of activity inevitably led to attempts to estimate the degree of inequality suffered by agricultural producers or the disparity that existed. The Department of Agriculture refrained from pushing forward income relationships on account of the difficulty of making estimates of income from agriculture and from other sources on a comparable basis and because of the difficulty of rationalizing these relationships. Much was being said and written about price relationships as an indication of purchasing power. First the available indices were used, that is, wholesale prices of agricultural against nonagricultural products. The Bureau constructed an index of prices farmers received for agricultural products and for a time they were compared with the wholesale prices of nonagricultural products. The next step was to set up index numbers of prices of commodities farmers buy, and they were used, accepted by

some without question as to their significance, and condemned by a few who usually underrate their value. The Agricultural Adjustment Act simply legalized a procedure which was being publicly used as an indication of the disadvantage of agriculture in the depression. The use of price relationships drew severe criticisms as the prices of farm products were advanced sharply by curtailed production on account of the drought and the Adjustment Program. Now the Soil Conservation and Allotment Act gives us an income parity problem.

The income comparison required by the Soil Conservation Act is on an historical base. It requires reducing to a purchasing power basis the net income per person on farms and the income per person not on farms, in comparison with a pre-war base. This involves the construction of annual income estimates comparable with estimates of the pre-war base period, and a cost-of-living index which represents the change between the present and that base. At present this is looked upon as a great improvement in the basis for measuring the balance of welfare or parity relationships between rural and urban conditions of living. It provides an incentive for improving the estimates both of income and of changes in cost of living. I now predict that before long some other basis of comparison will be required. The pre-war base will be criticized as being too far behind present conditions. What may be considered a more real measure of urban and rural relationships will be sought. I predict that, next year or the year after, we shall be pressed for better measures of real income for both town and country.

It is very difficult to determine purchasing power in terms of real values. Five hundred dollars of income to the man on the farm has a real purchasing power quite different from $500 in income to the man living in the city. And there is the additional problem of valuing goods and services not directly bought or hired. What values should be placed upon wide open spaces and scenery for the man in the country? He does not place a dollar value upon these things. He may place a dollar value on being close to the store, the post office, schools, and churches, but it is difficult to estimate these values. He is not buying them except by transportation costs to the village. Unquestionably the man in town must have more money to be as well fed as the man in the country. He must have more money to live as townspeople live, but with this he receives more service than does the farmer. The man of the town will pay something in the way of travel to get out into the wide open spaces and to have some of the scenery that the farmer enjoys free. Herein monetary comparisons fall down. Comparisons of relative changes are more valid, but still subject to criticism. The development of good roads, the extension of telephones and electric lines to the country have reduced materially the disadvantages of living in the country in the past few years, in comparison with pre-war. How can these changes be valued?

Coming back to a consideration of national income, let me offer a few suggestions as a starting point toward clarifying the field of income estimates for the public. Let there be one authoritative estimate of national income provided by a Government agency, with the several Government

agencies which are specializing in different fields contributing parts to the estimate of national income. Let the annual national income figure be an estimate of the net value of goods and services produced in the year. In computing this estimate, allowance should be made for maintenance of productive capacity and all duplications of values as between producing agencies should be eliminated. Changes in inventory should be included only in terms of net changes in physical volume, at current values, and shown separately in the breakdown of the estimate of national income. Goods and services for the year not entering into commercial exchange should be valued on the basis of current prices or charges for like goods and services, with due regard to the possibility of maintaining a reasonable degree of comparability through the period of years for which comparisons are most commonly made.

Annual national income estimates should be established for the period 1909 to date because of the frequent use of pre-war comparisons. Provision should be made for current preliminary estimates of national income for the year as early in that year as it is found possible to arrive at a figure that is likely to prove a fairly close approximation to the income of the year. It should be understood that the preliminary estimate is subject to check and revision within the following year; but the series should not be revised frequently beyond the revision of the last preliminary estimate.[1]

Establishing an authoritative annual estimate of national income, simply described and explained to the public, should not stand in the way of continuous research to improve basic elements in the estimates and to interpret or analyze the estimates. Let research workers produce other estimates of national income for special purposes, but label them carefully so as to avoid confusion in the public mind.

Mr. Warburton: Mr. Warburton stressed the importance of estimating the amount of the national income, or value of the national product, by the direct method of listing and evaluating the various items of consumption and of additions to capital facilities. Four purposes of such an estimate were emphasized. First, measurement of the national income in terms of end-products shows more clearly than any other method the essential characteristics of business fluctuations, revealing what segments of the economy fail in times of depression to produce their customary quotas of goods and services, and what segments are most stimulated in times of boom. Second, this type of measurement reveals the character of gradual alterations in the economy by indicating the changes in the proportions of the nation's productive energies devoted to each of the various kinds of end-products. Third, such a measurement is needed in connection with studies of productive capacity, since it is only when capacity to produce is related to the end-products which people wish to acquire that measurements of capacity have substantial significance. Fourth, this measurement provides a coordinated view of the national economy, and aids in placing an adequate emphasis upon the fact that the chief public purpose in governmental regulation of

[1] At this point the author has taken the liberty of extending his remarks in the record to carry out an idea to a logical conclusion.

or interference in economic life is to furnish to the people of the country the goods and services which they desire.

Mr. Warburton also mentioned a few of the difficult technical problems encountered in evaluating the various items of end-products: (1) inadequate information regarding retail values; (2) the difficulty of distinguishing between items purchased by consumers and those purchased by business enterprises; (3) evaluation of services such as education, medical service and relief provided by governmental authorities; (4) evaluation of illegal goods and services; and (5) separation of the net value of additions to capital facilities from the gross value, and the associated problem of segregating capital funds derived from capital gains and depreciation allowances from those derived from savings out of current income.

Mr. Nathan: The manuscript of a study of the national income, 1929–1935, prepared by the Income Section of the Bureau of Foreign and Domestic Commerce is now at the Government Printing Office. Data for 1935 will be ready in time to be added to the proof copy of the study. Also, the 1935 official estimates will be released shortly.

The National Bureau of Economic Research called a Conference on National Income and Wealth in January, 1936, with representatives of universities and both private and public research agencies in attendance, and arrangements have been made for a continuing organization of the Conference. The primary purpose of the Conference is the clarification of terminology, concepts, scope, etc., of income studies and the stimulation of research in this field.

It is possible to classify the national income in a great many ways. These classifications are of greater interest and importance than statements of the total income. For example, regional or geographic breakdowns of income data are exceedingly important. At the present time, it is only possible to make these breakdowns by states and these are only rough approximations; but it is hoped that at a later time the classifications can be made for areas which are relatively homogeneous in economic and industrial conditions. Nothing voluminous has been published on this basis since Maurice Leven's studies of 1929 and 1919–21. Monthly indexes of national income are also important and several of them have already appeared in the past year or so. The Bureau of Foreign and Domestic Commerce has been preparing a monthly index but it is not yet ready for publication.

Still more important are frequency distributions of income, not only by individual income recipients, but by families. There are some data which can be used for this purpose, but they are not entirely satisfactory and require careful analysis and experimentation. Among these data may be mentioned the financial survey of urban housing, the Federal income tax returns, the Federal study of consumers purchases now being conducted, and also a special tabulation and analysis of the Wisconsin tax returns which are important because of the low exemption limits. Ideally, a census of income is needed.

There is a great deal to be learned about the nature of the figures on

national income and their detailed characteristics. The Bureau of Foreign and Domestic Commerce is concentrating upon the improvement of estimates and the clarification of concepts. Improvements made by the agencies which are responsible for the collection of basic income data are reflected in the improvement of the estimates of the national income.

Among the more important problems in the field of national income estimates may be mentioned (1) the abuse of the estimates by the people who should know better and who might be expected to read the qualifying paragraphs which accompany the estimates, (2) the need for a clarification of terminology, (3) the complicated nature of the concepts, and (4) the contribution of government to the national income.

Mr. Bean, in discussing the statements made by Messrs. Stine, Warburton, and Nathan, pointed out: (1) that the provision in the Soil Conservation Act calling for a restoration of the prewar ratio of purchasing power of the net income per person on farms to the purchasing power of income per person not on farms has been utilized as a reason for stimulating research in farm and national income, and that a project has been set in motion in the Bureau of Agricultural Economics under funds supplied by the A.A.A.; (2) that it is necessary to bear in mind two types of research, the so-called "scientific research" that frequently is two or three years behind the time and "operating research" to meet the needs of agencies engaged in shaping current and future policies and responsible for action. "Operating research," as Mr. Bean defined it, consists of utilizing the best results available from "scientific research" and supplementing by additional research that calls for anticipating or approximating the truth, subsequently to be revealed by "scientific research" as closely as possible. He argued that in practical affairs where action must be taken whether by private or governmental agencies, a 90 per cent approximation today is better than a 95 per cent approach to the truth by "scientific research" two years after the need has passed. Mr. Bean illustrated his remarks with a chart showing national income (exclusive of farm income) by months from 1921 to date, together with the course of retail expenditures for livestock products, both series prepared by the A.A.A. and published in the April 1936 issue of the Agricultural Situation of the U. S. Department of Agriculture.

In the general discussion it was pointed out that it would be valuable to have several estimates to suit different purposes, in spite of the confusion of terms and concepts which accompany them. It was shown that in the preparation of estimates important items in the national income might very easily be overlooked or duplicated. With respect to the demand for statistics before they can be prepared with scientific accuracy, one discussant pointed out that statisticians are largely to blame since they have conveyed to Congress the notion that statisticians can furnish figures almost instantly which are adequate for the basis of legislation vitally affecting great masses of people. Another discussant remarked that, "Many of us are reluctant to say, 'We just don't know. We cannot afford to give you a figure that can only be abused.'"

STATISTICAL NEWS AND NOTES

SECURITIES AND EXCHANGE COMMISSION.—During its second year (ended June 30, 1936) the Securities and Exchange Commission has considerably expanded the scope of its statistical activities. However, so far only a small part of the material collected has been released for publication. The more important statistical data released (for statistics released before June 30, 1935, see this JOURNAL, vol. 30, 1935, pp. 608–609), include:

1. Figures on purchases and sales of certain groups of members of the New York Stock Exchange and the New York Curb Exchange during the period from June 27 to December 18, 1935, contained in the Commission's report on "The Feasibility and Advisability of the Complete Segregation of the Functions of Broker and Dealer." Comparable figures have been regularly reported to the Securities and Exchange Commission since March 2, 1936 and may be released soon.

2. Data on brokers and dealers in securities registered with the Securities and Exchange Commission (Release No. 523).

3. An extensive list of about 27,000 reports by officers, directors and principal stockholders of about 1,800 corporations with securities fully listed on a registered securities exchange as at December 31, 1935, on their holdings in equity securities of such corporations was published by the Commission, together with certain summary statistics based on these data, in July, 1936; more detailed statistics may be released in the near future.

The statements filed by approximately 2,000 corporations in connection with their registration under the Securities Exchange Act of 1934 are being analyzed in a WPA project, "Census of Listed American Corporations," supervised by the Securities and Exchange Commission. It is expected that a considerable amount of statistical data will be released in the fall.

Comprehensive statistics on investment trusts and investment companies have been collected in connection with the Commission's study authorized by Section 30 of the Public Utility Act of 1935. Part of this material will most likely be included in the report which the Commission has been ordered to render to Congress on or before January 4, 1937.

BOARD OF GOVERNORS OF THE FEDERAL RESERVE SYSTEM.—The Board of Governors of the Federal Reserve System appointed George W. Blattner, who has been a member of the Board's research staff since 1929, an Assistant Director of the Division of Research and Statistics, effective May 1, 1936. The principal lines of work of the division will be in charge of the three assistant directors as follows: Credit and business developments, under Woodlief Thomas; monetary problems, under Lauchlin B. Currie; and problems of bank structure and supervision and statistical work of the Reserve banks, under Mr. Blattner.

The Board's seasonally adjusted index of factory employment is being revised on the basis of the revised unadjusted index recently published by the Bureau of Labor Statistics. Revised seasonal adjustment factors and

seasonally adjusted indexes are to be published by groups and by industries in the current issue of the *Federal Reserve Bulletin*.

FEDERAL DEPOSIT INSURANCE CORPORATION.—The Annual Report of the Federal Deposit Insurance Corporation for the year 1935 has been issued. The report is similar in form and content to that issued last year, and describes the changes in deposit insurance structure and in the operations of the Corporation resulting from inauguration of the permanent plan of insurance provided for in the Banking Act of 1935. The report also contains more detailed information than has heretofore been available regarding the size and class of banks, branch banking, changes in banking structure, bank earnings and profits, and examiners' appraisals of the condition of banks.

FEDERAL TRADE COMMISSION.—Recent reports of the Federal Trade Commission include several which are of interest to statisticians.

A short report with a long title, on milk, was recently sent to the Congress, namely, Report of the Federal Trade Commission on Milk Market Regulation and Practices of Distributors in Relation to Margins, Costs and Profits of Distributors in Boston, Baltimore, Cincinnati, and St. Louis.

The textile inquiry of the Commission, which apparently will end next December with a report on the results for the first half of 1936, continues to furnish reports from time to time, which sometimes include special features besides the standard data. The general data and comparisons go back to the beginning of 1933. Among the more recent reports sent to Congress, is one entitled Woolen and Worsted Textile Industries, first half of 1935, which contains novel data on costs per yard and per pound. A report was also recently issued covering Cotton Textiles for the same period.

The Congress just before adjournment passed the Gearhart resolution regarding fresh fruits, vegetables, etc. (Public Resolution No. 112, 74th Congress). This extends the scope of the so-called Agricultural Income inquiry which includes among other things comparison of farm income with that of corporations manufacturing, processing and distributing farm products, the partition of the consumer's dollar paid for such commodities among the various factors of production, etc.

The Congress also passed a resolution calling for a new inquiry into the farm implement and machinery industry (Public Resolution No. 130, 74th Congress). Among the statistical data called for are prices, including comparisons with the prices of other commodities and also costs, margins and profits.

No appropriation, however, was made for these two studies and the effect on their progress is more or less a matter of speculation.

BUREAU OF FOREIGN AND DOMESTIC COMMERCE.—A revision and expansion of that portion of the *Market Data Handbook* (*1929*) dealing with consumer statistics was available for distribution late in June. This *Consumer Market Data Handbook* presents in a practical manner the more important statistics necessary to an evaluation of the consumers' market. Much data

is given for towns of 2,500 population and over, others by counties and states. Sources of other pertinent statistics are also given.

The annual number of the *World Economic Review*, which was published during June, presents in summary form the outstanding economic developments in 1935. The progress of economic recovery throughout the world is shown in the present study. It also discloses that, although substantial progress toward recovery has taken place in the United States, such progress was characterized by considerable unevenness. The major trends are reviewed, together with a summary of the principal adverse factors which are still exercising a drag upon recovery.

In the near future it is expected that the 1936 supplement to the *Survey of Current Business* will be available. This volume will present monthly figures from 1932 to 1935 inclusive, as well as monthly averages, were available, from 1913 up to and including 1935. The previous supplement (1932) contained monthly data from 1923 to 1932. Due to the addition of new series and the revision of existing ones, many changes have occurred in the various time series during the past four years.

The study of "Long Term Debts" has been completed by the Division of Economic Research and will be available shortly. As reported in the last issue, this study will deal with (1) changes in the volume of long-term indebtedness since 1913 by principal classes of borrowers, (2) changes in annual interest charges, (3) the volume of obligations in default at different dates, (4) comparative ages of the classes of debt outstanding in 1933, and (5) the ownership of the evidences of debt.

The Division has also published a comprehensive volume on *National Income 1929–1935* showing estimates for twelve major industrial divisions and about 40 subdivisions. The book includes estimates of the number of persons employed and their per capita income; also classifications of income by types of payment. The July issue of the *Survey of Current Business* contained an article "Expansion of National Income Continued in 1935," reprints of which may be obtained from the Division of Economic Research.

Regular monthly releases are now being made on manufacturers' and wholesalers' sales and collections on accounts receivable by kinds of business; also by geographic areas for the wholesale data. This program is being carried out in cooperation with the National Association of Credit Men.

The annual *Retail Credit Survey* containing 1934 and 1935 data for more than 1,500 firms in some 88 cities, has been released. Among other significant facts, it is shown that (1) payments on both open and installment accounts receivable were made more promptly during 1935 than in 1934, (2) the ratio of credit sales (open account and installment combined) to total sales increased for twelve of the fourteen kinds of retail stores studied, and (3) that bad-debt losses decreased materially in 1935, being only about one-half of the 1934 ratio.

The States of Arkansas, Iowa, Kansas, Missouri, and Nebraska have been added to the nine already being covered by the Bureau's independent retail sales reporting program. It is planned to add to the service very soon the

six New England States (Maine, New Hampshire, Vermont, Massachusetts, Connecticut, and Rhode Island).

The first of a series of publications on "Basic Industrial Markets in the United States" was released in June. This series is designed to offer industrial marketing executives a quick and accurate picture of the size and location of those sections of their markets represented by the various basic industries. The first volume in this series covers textiles.

"The Balance of International Payments in 1935" has been published by the Finance Division, which Division also issued (in June) a special circular (No. 417) analyzing the approximately five billion dollars of "Foreign Investments in the U. S."

"The Construction Industry" published last April was the first of a series designed to present in summary form information of specific industries as well as the leading trade associations within the industry. "The Foodstuffs Industry," the second of this series is in press and a bulletin on "The Lumber Industry" is in preparation.

"Markets for Electrical and Gas Facilities" has been completed and "Markets for Plumbing and Heating Facilities in Residences" is in press.

The Bureau has recently completed a study of "Store Modernization Needs" based upon a physical appraisal of some 8,000 small stores in 23 selected cities. A check sheet by which a merchant can evaluate his own needs and plan of business is attached to this volume.

The widely-used studies of the Bureau, "Consumer Use of Selected Goods and Services, By Income Classes," constitute the first primary research of its kind based upon substantial samples. The nine reports issued to date provide information on 1933 income and use of "durable goods" items by a representative number of families in Austin, Tex.; Fargo, N. D.,; Portland, Me.; Columbia, S. C.; Salt Lake City, Utah; Trenton, N. J.; San Diego, Calif.; Racine, Wis.; and Birmingham, Ala. (10 cents each, Bur. For. & Dom. Com.). The next report will include (in one publication to be released this Fall) similar data for each of nine other cities evenly distributed throughout the United States. (Burlington, Vt.; Casper, Wyo.; Des Moines, Iowa; Erie, Pa.; Frederick, Md.; Lansing, Mich.; Paducah, Ky.; Portland, Ore.; Oklahoma City, Okla.).

An "Estimate of the Volume of Wholesale Trade in the United States, 1899–1935" by N. H. Engle, Assistant Director of the Bureau, appeared in the May issue of the *Survey of Current Business*. Reprints are available.

A revised edition of a study of the "Outstanding Factors Affecting Foreign Trade Policy" was published in May.

Domestic Commerce Bulletin No. 94 on "Confectionery Production and Distribution, 1935" was released in June. "A Review of the American Machinery Industry" also appeared during this month.

BUREAU OF AGRICULTURAL ECONOMICS.—Revisions for acreage, yield, and production of certain major crops for the years 1924–35 have been made by the Crop Reporting Board, U. S. Department of Agriculture, and are avail-

able in mimeographed form. These revisions were made after consideration of the enumerations of the Census of 1935.

A new series of mimeographed reports on special phases of the work of the Division of Crop and Livestock Estimates was begun in late May with the issue of an article entitled "Effective Precipitation in Relation to Crop Yields," by Anna P. Kelly and Joseph L. Orr. Others of the series will be issued occasionally.

"Livestock Meats and Wool Market Statistics and Related Data, 1935" has been completed and is now available. The favorable reception of the first two editions has encouraged the authors to prepare additional matter, besides bringing customary tables through 1935. Special attention has been paid to long-time series.

The agricultural statistics which for years have been carried in the *Yearbook of Agriculture* will this year be available as a separate volume, entitled *Agricultural Statistics, 1936*.

Cost of crop insurance is being studied in a research project of the Division of Agricultural Finance by William H. Rowe, assisted by E. L. Cady of Iowa State College. Work in Kansas, Oklahoma, Texas, Nebraska, North Dakota, and Montana is contemplated, based for the most part on data acquired by the Agricultural Adjustment Administration incident to the adjustment programs.

INTERSTATE COMMERCE COMMISSION.—The Interstate Commerce Commission has begun issuing statements of estimated monthly revenues of railways, freight, passenger, and total, for the Eastern, Southern, and Western districts, giving percentages of increase over same month of previous year about three weeks in advance of the totals compiled from the final sworn reports. The new statement is based on the estimates furnished by such individual railway companies as regularly compile them for their own information.

DIVISION OF ECONOMICS AND STATISTICS, FEDERAL HOUSING ADMINISTRATION.—This Division, in cooperation with the Large Scale Housing and the Comptroller's Divisions of the Federal Housing Administration, is conducting a study of the operating experience of apartment houses throughout the country. The schedules have been planned to embrace into a single uniform system a wide variety of accounting methods. The main breakdowns may be classified according to three divisions: (1) yearly statements of assets, liabilities and capital, incomes, expenses; (2) analyses of dwelling units (furnished, unfurnished, rental charged), replacements, indebtedness, payrolls, repairs; and (3) miscellaneous information, including square foot area, cubic content, space devoted to stores, type of building, services provided, and a short history and description of the neighborhood. Representatives of the Federal Housing Administration are transcribing data from organization records to the schedules. Almost 500 New York and Chicago apartment buildings, each containing a minimum of eighteen dwelling units, are being

studied at the present time. The field work of gathering data on 100 apartment buildings in Washington, D. C., is under way. The project may be broadened to include an equal number of buildings in one Southern city and in one Western city. It is hoped that, through the development of a uniform system of accounting as well as more comprehensive analyses of these data, a deeper understanding of revenue trends and costs of operation may be reached, and that aid may be given to stabilizing the market for multiple family houses. A "Uniform System of Accounts" for large scale housing projects has been prepared and published.

The manuscript of a study entitled "Financial Analysis of Large Scale Housing Projects" has recently been completed, having as its object the development of a method by which the economic soundness of a housing project may be tested, and by which the adequacy of the predicted revenue in meeting cash requirements under a financial plan may be measured. This analysis takes cognizance of the fact that the relationship between debt and value at the initiation of a project is an inadequate measure of the security for the loan throughout the term of the loan. The procedure is designed to show whether a particular financial plan under a given revenue assumption can be successfully undertaken without undue risk. Should the selected plan appear to be too burdensome, the technique will measure the change necessary in any given one of its elements in order to make it conform to the productivity pattern of the project. The method followed is, first, to define the various forces affecting the financial situation in which the project is to operate; second, to test the economic soundness of the project by comparing the actual capital cost with the investment-amount justified by a refined income appraisal extending over the economic life of the project, and finally, to analyze the financial plan so that the predicted balance available for debt service thus obtained may be tested in the light of the annual repayments required by the proposed financial plan.

An analysis of family rental expenditures in relation to family incomes in 43 cities has been completed. The analysis is based on the data presented in the Financial Survey of Urban Housing conducted by the Bureau of Foreign and Domestic Commerce. The purpose of the analysis has been to secure a measure of the customary family expenditure for housing at various income levels which will provide a basis for the adjustment of amortization schedules to suit the income of the borrower and to determine the validity of Engel's expenditure laws with respect to housing. The results of the analysis will be published in the near future.

The actuary of the Division has prepared two sets of yield tables for 5 per cent monthly amortized mortgages. The first set of tables shows the yield earned on these mortgages for terms of 10 to 20 years purchased at or above the amount due on the mortgage. The assumed purchase price varies from 100 per cent to 110 per cent of the balance due. The second set of tables shows the yield earned on these amortized 5 per cent mortgages purchased at the unpaid balance for varying terms of mortgages, and exchanged for 3 per cent debentures upon default of mortgage payments. Both of these

sets of tables are shown on the semi-annual conversion basis, the customary basis for quoting yields of bonds, as well as on the effective annual basis.

The Washington, D. C., Real Property Inventory, the data for which were gathered in 1934 under the auspices of the Civil Works Administration, has recently been tabulated as a Federal Works Progress Administration project in Philadelphia under the sponsorship of this Division. Insofar as possible the tabulations outlined in the "Technique for Real Property Survey" (discussed in the Statistical News and Notes Section of the December, 1935, issue of this JOURNAL) have been adapted to the original schedules. Tabulations by city blocks and by census tracts and a detailed tabulation for the city as a whole have been made. In addition, the study includes maps presenting average rent, condition of structure, race, and other pertinent factors for each city block.

The field enumeration in connection with the financial survey of housing in Kansas City, Kansas, was completed last year. The data were gathered under the supervision of this Division as a Works Progress Administration project. Practically all tenants and all owners of residential property have been covered by the project. The survey contains a number of revisions in the schedules and in the tabulations as contrasted to former surveys of this type. The tabulation and analysis will be completed in the near future.

A technique is being developed which should prove valuable to governmental agencies concerned with housing construction and financing, and to private institutions investing in mortgages or real estate. Its purpose is to provide a method of preparing a detailed analysis of real estate transfers, real estate mortgages, distress sales of real property, and lots subdivided or platted, on the basis of material available in the official records of the local government. It is hoped that the technique will be adopted in surveys carried forward as Works Progress Administration projects in a number of cities throughout the United States.

UNITED STATES BUREAU OF LABOR STATISTICS.—A study of the legal-aid movement in the United States, prepared by Reginald Heber Smith and John S. Bradway, has just been published as a Bureau bulletin. It represents a complete revision of the earlier bulletin on the same subject, issued in 1926.

Bituminous coal mining and shipbuilding will be the next of the major industries to be covered by wage surveys, according to present plans. The survey of entrance wage rates of common labor, made each July by the Bureau, will be extended this year to cover a number of industries not included in former surveys.

The Bureau is undertaking a revision of its directory of cooperative societies, last issued in June 1934. In this work other Federal agencies are cooperating. Thus a much wider coverage is expected to be obtained than has heretofore been possible. On the basis of the data obtained, a statistical survey will be made later.

Beginning with July, the reporting of retail food prices was changed from a bi-weekly to a monthly basis. This was made necessary by a reduction in

the Bureau's appropriation for the current fiscal year. Also, as a measure of economy, arrangements are being made with a number of cooperating State offices by which much of the tabulation in connection with the monthly employment statistics will be done in those offices instead of in Washington.

Surveys of operations under the old-age and blind pension acts of the various States in 1935 have been completed. Reports on both will appear in the *Monthly Labor Review*. The Bureau has been collecting data on old-age pensions each year beginning with 1928, but blind pensions were covered for the first time in 1934.

UNITED STATES EMPLOYMENT SERVICE.—*Second Nationwide Survey of Registered Job-Seekers:* Since November, 1935, the United States Employment Service has been engaged in the establishment of an organization for securing periodic detailed inventories of all job-seekers registered with public offices throughout the country as actively seeking work. Through this Inventory Program a complete punched card file giving detailed information concerning the individual job-seekers has been established and integrated with the regular reporting system of the Employment Service. The first nationwide survey of job-seekers made through this organization was completed early in July. A second nationwide Inventory survey of active job-seekers is being taken covering the records of all applicants actively registered with Employment Service offices on July 1, 1936. Work on the tabulation of this material is now well advanced. It is expected that final tabulations of the material will be completed late in September.

The reports made available through the analysis of the active file records of employment offices give the detailed classification of the industrial background in which applicants were formerly normally employed, the occupational classification in which they are seeking employment, their age and, in the case of veterans, their classification with respect to dependency and disability status. These tabulations are prepared on the basis of individual cards prepared for each applicant and are maintained strictly up to date through the operations of the regular reporting system of the Employment Service.

The tabulations of the active file inventory for the Employment Service comprise one of the largest current samples of detailed information concerning the characteristics and distribution of job-seekers in existence. The inventory records cover not only unemployed job-seekers but all persons working at security wages on relief works projects and also a small proportion of person employed but seeking better work opportunities.

Offices of the United States Employment Service, whose active file records are tabulated in these inventory surveys, are operated in every sizeable community in the country. Through an integrated system of affiliated state employment service offices and supplementary National Reemployment Service offices operating under the direction of the United States Employment Service, reports are prepared in accordance with a uniform standard

reporting procedure. The observance of the standard reporting procedure and the fact that reports are prepared by an experienced and trained personnel insures that the information received throughout the country is available on a uniformly comparable basis. Tabulations are prepared for each state and for each employment service district in the country.

The existence of these nationwide surveys of job-seekers provides a hitherto unavailable source of information. By means of these reports it is possible to make studies of the varying conditions in different sections of the country and to contrast the characteristics and distribution of the various age, relief, occupational and industrial groups. Each of the basic tables contains cross-classifications indicating sex, color, relief and veteran status. By this means it will be possible to obtain the information for any one of the sub-groups which is given for the main table. Thus, for instance, the age tabulations of relief men and relief women can be contrasted with those of the non-relief group, etc.

Information secured through the Inventory surveys is available for use in two forms. At the conclusion of each survey a digest of the results for the entire country is published by the Division of Standards and Research, United States Employment Service, in Washington. This report includes complete tables of nationwide figures and also indicates the distribution of applicants through the various states. The detailed figures for the individual states and for communities within each state are available through the offices of the respective state directors of the Employment Service. In addition many state services have issued brief summaries of the inventory reports prepared for their localities. In case any difficulty is encountered in securing desired information, communication should be addressed to the Associate Director for Standards and Research, United States Employment Service, Department of Labor, Washington, D.C.

Occupational Research Program: A recent issue of the JOURNAL described the objectives of the Occupational Research Program which the Employment Service is conducting. The Program has recently completed descriptions of jobs in the following industries in addition to those previously announced: Retail Trade, Foundry and Machine Shop, Hotel and Restaurant, and Domestic and Personal Service. Trade questions for thirty occupations in the construction industry have been standardized and are ready to be published in suitable form for employment office interviewers. The questions after being collected and edited were tried out on skilled workers in the various trades and also on persons in closely related occupations. Questions which differentiated the respective skilled groups significantly from other groups were retained.

Several studies have been completed in an effort to discover objective means of measuring the potentialities required of workers in three clerical occupations and in certain department store sales positions.

DIVISION OF SOCIAL RESEARCH, WORKS PROGRESS ADMINISTRATION.—*Special Inquiries.* Several special inquiries have been undertaken within

the past few months designed to show the effects of the Works Program as a whole and of certain administrative policies on workers in selected communities. Surveys of workers certified for Works Program employment were conducted in 15 cities and one rural area; the information assembled includes reasons for failure of workers to take employment on the Program, duration and continuity of Works Program employment, monthly earnings, and supplementary relief received. Reasons for failures to accept assignments to Works Program employment are reported in two bulletins, one for urban and rural communities of Ohio and the other for the 13 cities included in the survey of former urban relief cases. Separations of workers from Works Program employment were studied in order to ascertain the reasons why workers left their Works Progress Administration jobs and their ability to get along subsequently. Additional studies of this nature are planned for the future.

Charges that Works Progress Administration workers are unwilling to accept available private jobs have been investigated in a number of areas, notably Colorado, Montana, Utah, and New York City. Similar surveys were made last year in six communities covering a variety of rural and urban industrial situations.

Following the cessation of grants from the State administration, a comprehensive survey was made of the relief situation in twelve New Jersey communities. Data were obtained on incomes before and after the closing of emergency relief administration cases and the current economic status of cases as indicated by diet, housing, and immediate, urgent needs.

Studies of Relief and Welfare Legislation. A study of legislative trends in public assistance, 1929–1936, and a digest of poor relief laws in the several States and territories have recently been completed. An historical study of general relief legislation (48 States) and a study of trends in welfare expenditures in eleven selected States is in preparation. Digests of State legislation and administration provisions for public assistance are being published for all States and territories.

Survey of Rural Youth. A complete population enumeration and a detailed study of all youth 15–29 years of age in 45 of the 140 villages included in the Re-survey of Agricultural Villages is now in process. This survey has been made possible by a grant from the American Youth Commission, under the American Council on Education. Disbursement of funds will be handled through the Columbia University Council for Research in the Social Sciences. The field work is the responsibility of the Works Progress Administration State Supervisors of Rural Research and should be finished before the end of the summer.

Study of Migratory Workers. An analysis is being made of the work histories of several hundred migratory-casual workers for the years 1933 and 1934. Cases have been selected to furnish examples of the travel routes, occupations, periods of employment, earnings, etc., for workers included in the casual labor force of the various States.

Bulletins and Reports. Preliminary figures showing the relative cost of

living in 59 cities in the United States are presented in Research Bulletin Series I, No. 20. A report on unemployable relief cases in thirteen selected cities has been released as Research Bulletin Series I, No. 19.

At this time twenty reports are in preparation for issuance in monograph form during the present year. These reports concern surveys and studies for which some preliminary findings have been published in bulletin form during the past two years.

DIVISION OF RESEARCH, STATISTICS AND RECORDS, WORKS PROGRESS ADMINISTRATION.—In previous issues of this JOURNAL comment has been made on various aspects of the system of statistical reports covering the Works Program which is the responsibility of the Works Progress Administration and particularly of its Division of Research, Statistics and Records. This system involves not only reports on the activities of the Works Progress Administration but also reports on the other Federal agencies having administrative responsibility for work projects financed through the Emergency Relief Appropriation Act of 1935. The following paragraphs summarize the various phases of this reporting system.

Reports Received from the Area Statistical Offices. In the Area Statistical Offices regular reports on the Works Program are prepared currently from operating and accounting documents received from Works Progress Administration state or district offices and from projects of other agencies engaged in the program. Two reports, both of which cover other Federal agencies participating in the Works Program as well as the Works Progress Administration, are of outstanding importance. A semi-monthly report shows the total number of persons employed by sex, the total hours worked and credited, and total earnings. In addition, the total number of persons, hours on which payment was based and earnings are shown separately for persons from the relief rolls and those not from the relief rolls. These data are given by counties separately for the Works Progress Administration and for each other Federal agency. Another report shows the number of different persons working at any time during the month on projects for the Works Progress Administration or any other Federal agency. This report is prepared by county of residence of persons employed and shows the number of persons by sex and by previous relief status.

Other regular reports present in more detail special aspects of the Program. In addition, current reports are made covering such information as purchases and contributions of materials, classified both by type of materials and type of project on which used; purchases and contributions of rentals and services other than materials; and sponsors' funds made available for the Works Program.

Special reports are prepared by the Area Statistical Offices from time to time at the request of the Washington Office. Numerous documents such as copies of payrolls, purchase orders, and employment records for each person assigned to the Program are on file in the Area offices. In some instances, therefore, it is possible to conduct large tabulations on a sample basis,

since the documents are centralized. Among the more important of the special reports is that on Works Progress Administration projects selected for operation showing the number of projects selected in each State since the beginning of the Program, their total approved cost estimate including both Works Progress Administration and sponsors' funds, and the estimated direct labor costs as compared with other operating costs (materials, supplies, equipment, etc.), each classified according to type of project. Another tabulation is that made from the individual employment records maintained for each person assigned to a work project. This summary includes total employment, both by type of project and by occupational classifications, assigned monthly wage rates, and actual monthly earnings for persons employed on projects of other Federal agencies as well as of the Works Progress Administration.

Data Covering Works Program Activities of Other Federal Agencies. Statistics maintained by the Division of Research, Statistics and Records, covering the activities of other Federal agencies, involve primarily employment and payrolls, accounting and financial data, and data on the physical status of projects. Payroll documents similar to those covering Works Progress Administration employment are routed to the Area Statistical Offices from Federal agency projects. Owing to the time lag necessary for tabulation of data from these payrolls and in order to provide more immediate information on employment, each agency reports an employment count to the Works Progress Administration five days after the close of each week. Accounting and financial data covering each agency are based on records maintained by the Treasury Department, which provides cumulative figures on allocations to each agency as well as obligations incurred and expenditures made by it. The Division maintains a detailed record of the operation status of the several thousand projects conducted by other agencies. Starting with the Presidential letters of approval, containing information on funds allocated for the projects, their location, and miscellaneous descriptive material, this record also covers subsequent data on the award of contracts, the physical progress of each project, and, finally, the completion of the work.

Research Activities. The Division of Research, Statistics, and Records of the Works Progress Administration has inaugurated an investigation into the relation between the various relief programs and the status of labor in the country. During the summer months a group of economists has been studying the relief problem in its relationship to the status of labor in thirty-three communities in the United States.

In connection with the conduct of this investigation a study has been made of the methods of establishing prevailing rates which have been used by various agencies of the Federal government and under the various state laws. Data have also been gathered on rates of wages for the entire country. These data are being recorded on standard cards in order that they may be useful not only for the purposes of the investigation but for the use of any other agency. Several other Federal agencies, especially the Bureau of Labor

Statistics, have undertaken to cooperate with the Works Progress Administration in conducting statistical studies of actual rates of wages throughout the country.

Another phase of the research work of the Division involves a comparison and analysis of trends in employment and trends in relief in a number of local areas where reasonably adequate data are available. At present the analysis includes Philadelphia, Pittsburgh, and a number of counties in Ohio. The analysis will be extended to other local areas where adequate data permit such a study. This investigation covers, for the most part, the period 1932–1935. The paucity of suitable relief data before 1932 makes it virtually impossible to study these trends during the course of the entire depression. This analysis of employment and relief trends will attempt to compare areas of markedly different industrial instability characteristics. This involves comparing relief and employment trends in areas dominated by durable goods industries with areas producing predominantly non-durable goods.

A comprehensive analysis of construction statistics is also being undertaken by the Division.

Continuation of Relief Statistics. As the result of an attempt to continue in modified form the reporting procedures established by the Federal Emergency Relief Administration, the Works Progress Administration has established cooperative relationships with most states and is now obtaining reports comparable with those obtained for 1933–35 from about three-fourths of the states.

In many states Departments of Public Welfare, which administer general assistance together with aid to the blind, the aged, and to dependent children, have established adequate reporting procedures which cover all general relief from public funds. In other states, in which the continuation of the state emergency relief administration is assured, reporting procedures have changed very little; however, in a few of these states the decline in the number of families receiving unemployment relief has reduced the proportion of relief administered through the emergency relief administration and made relatively more significant the general outdoor relief administered by local officials. It has been possible to obtain supplementary reports on such relief through the state emergency relief administration in several states, but in others inadequate staffs in the state organizations have made this impossible at least for the time being. In twelve states no state funds have been provided for general relief so that financial responsibility lies entirely in the hands of local officials; no central administrative organization is provided and no statistical reports are obtainable at the present time.

The fact that special sessions of legislatures may change the status of relief administrations makes it difficult to predict the future status of relief statistics but it is probable that for the rest of the year a group of states which includes about three-fourths of the population of the United States will be able to furnish reasonably complete and comparable reports.

NATIONAL RESEARCH PROJECT, WORKS PROGRESS ADMINISTRATION.—In the preliminary outline of the study of *Re-employment Opportunities and Recent Changes in Industrial Techniques* a program was laid out for investigations along the following lines:

1. Plant surveys of changes in productivity in certain industries.
2. Statistical studies of changing productivity.
3. Surveys of occupational and social changes.

Work is progressing along all three lines of activity.

Plant Surveys of Productivity. Productivity studies are being conducted in a number of interrelated industries selected in order to make possible a composite picture of the effect of technological and managerial changes. These studies will cover selected portions of manufacturing, mining, transportation, agriculture, and other industrial groups. Most of the studies are being carried on in cooperation with other agencies. The Bureau of Labor Statistics is cooperating in surveys of the following industries: boots and shoes, leather, textiles, automobiles, iron and steel, plate glass, and rubber tires. The National Bureau of Economic Research is collaborating in a more comprehensive survey of industries previously examined by the Bureau: brick and tile, cement, lumber, beet sugar, and flour milling. In the extractive industries the Bureau of Mines is assisting in the tabulation of information which it has already collected. These data will be supplemented by field surveys wherever necessary for a more complete picture.

Changes in production methods in agriculture together with their effect on the number of workers required and the volume of production are being investigated by field surveys in selected crop areas. A technical committee set up by the Bureau of Agricultural Economics is cooperating in the direction of this work. Working agreements are under discussion with other Federal agencies.

Statistical Studies of Changing Productivity. A statistical staff is engaged in the assembly and evaluation of all available data on employment, manhours, and production in various industries, including manufacturing, agriculture, transportation, communication, mining, etc. This section is examining the limitations of available statistics, making necessary adjustments wherever possible and constructing productivity indices. In addition, the staff will attempt to estimate the amount of unemployment resulting from technological and managerial changes.

Surveys of Occupational and Social Changes. Sociological surveys are being made to gather information on the occupational histories of selected groups of displaced workers and on the characteristics of various types of stranded communities. The studies are designed to provide a factual basis for analysis of what has happened to displaced workers.

The Industrial Research Department of the University of Pennsylvania is collaborating on a study of work histories in Philadelphia. Material on occupational and social history is being obtained from field studies and from the Philadelphia State Employment Office records.

Arrangements are under way to obtain data on occupational shifts from schedules used in surveys conducted by the United States Public Health Service, the Bureau of Foreign and Domestic Commerce, the Milbank Memorial Fund, and the Bureau of Education. Tabulation of data from the files of the Civil Service Commission is also contemplated.

The majority of the field surveys of stranded communities will be conducted during the summer, utilizing students and faculty members of various universities from which previous surveys of a similar nature have been undertaken. Among these institutions are Harvard University, Smith College, University of Illinois, University of Wisconsin, and Newark University.

Supplementary Activities. In conjunction with the field surveys of productivity changes and of social consequences of displacement, it is planned to assemble and evaluate whatever previous investigations have been made along these lines. To this end research staffs have been functioning in the several fields gathering published and unpublished material available in the files of various government and private agencies.

WOMEN'S BUREAU, U. S. DEPARTMENT OF LABOR.—A Women's Bureau bulletin on "The Employment of Women in Department Stores" is now in press. This study shows conditions in the general mercantile industry prior to the Retail Trade Code of the NRA, the source being data obtained from 46 stores in 17 cities in 5 states. In addition to wage and hour and personal data for the individual employee, the study covers certain policies of management as to changes in method of pay and in hours, source of extras, and spread-the-work plans that were prevalent in late 1932 or early 1933. Information on hours and wages is published for six areas: New Jersey, Little Rock and Fort Smith, Denver, Los Angeles, San Francisco and Oakland, and Seattle.

Also in press is a report on "Piecework in the Silk Dress Industry." This study shows the effect of a minimum weekly wage on the earnings of pieceworkers, together with production variations under uniform hours in 9 dress centers, namely, New York City, the Eastern Area (including the suburbs of New York, New Jersey, and Connecticut), Boston, Philadelphia, Cleveland, Chicago, St. Paul and Minneapolis, St. Louis, and Los Angeles. Pay-roll records were obtained from 305 establishments for a 4-week period in the spring of 1933 before the union agreement or the code had been established, and for a 4-week period after the new hour and wage provisions had become effective. Corresponding production records were obtained from books kept by the workers themselves, and in some cases from the books of the firm. For New York City it was possible to examine the records in more detail, and to make comparisons between contract and inside shops. Workers in New York consistently showed higher earnings and production than those in other centers.

CHILDREN'S BUREAU, U. S. DEPARTMENT OF LABOR.—*Child Labor in the Production of Sugar Beets*: Field work has been completed and tabulation of findings is under way in the study of child welfare among sugar-beet

laborers' families undertaken last fall by the Children's Bureau in the sugar beet growing areas of Colorado, Michigan, Minnesota, Montana, Nebraska, and Wyoming. With the cooperation of both producers and laborers, nearly 1,000 families were interviewed. These families included more than 2,200 children 6 and under 16 years of age. The study gives some concrete evidence of the effectiveness of the AAA sugar beet production control contracts providing that no child under 14 years of age should be employed in beet-field labor and that children between 14 and 16 years of age should not be permitted to work longer than 8 hours a day. In 1934, before such control became effective, more than one of every four children between 6 and 12 years of age, or 28 per cent, was reported to have been employed at beet work in the families included in the study. In 1935 only 9 per cent of the children of this age group were reported as working. For the 12- and 13-year-old group the proportion employed dropped from 84 per cent in 1934 to 51 per cent in 1935, a reduction of a little more than one-third. Many of the growers interviewed expressed the belief that employment of older workers was preferable not only for the protection of children but in the interests of efficiency.

Monthly Reporting of Employment Certificates Issued to Children: During the 15 years since 1921 a steadily increasing number of state and city officers issuing employment certificates to children of legal working age have been reporting annually to the Children's Bureau the number of first working papers issued to such children. The Bureau has now secured the cooperation of practically all of these officials in reporting the issuance of employment certificates on a monthly basis. For the period from May 28, to December 31, 1935, reports were received from 12 states and 107 cities, 750,000 or more population, in other states. Tabulation of these reports indicated that in the seven months following the decision of the Supreme Court in the Schechter case, bringing to an end the operation of the NRA codes, the number of 14 and 15 year old children going to work in these states and cities was 55 per cent greater than in the entire 12 months of 1934. The collection of statistics on a monthly basis will, it is hoped, help to show whether children receiving certificates upon the closing of school in the spring are employed for the vacation period only or whether they have permanently left school for work.

Study of Industrial Homework: Field work has been completed in a study of industrial homework undertaken in 1935 by the Children's Bureau and the Women's Bureau with a view to ascertaining how successfully workers and employers had become adjusted to the abolition of homework during the NRA and whether they had returned to homework following the end of NRA. The industries covered were men's clothing, tags, men's neckwear, medium- and low-priced jewelry, and artificial flowers. Five hundred home workers were interviewed and 125 employers were visited in the course of the study. Tabulation of findings is now under way. The study indicates that the men's clothing industry and the tag industry had so adjusted and reorganized their work that up to that time there had been no return to the

homework system, but that in the other three industries home workers are again being employed.

U. S. PUBLIC HEALTH SERVICE.—Research activities of the United States Public Health Service are being expanded under the provisions of the new Social Security Act. Among projects now in progress (aside from purely laboratory studies) may be mentioned the following, all of which utilize statistical procedures.

Child Hygiene (Growth and health of school children, nutritional indexes; current obstetric practice; hearing of school children, etc.)

Dental Studies (Chronic endemic dental fluorosis or mottled enamel.)

Dermatosis (Occurrence of industrial dermatosis, outbreaks among users of manufactured products.)

Epidemiological (Special studies as need arises; chiefly concerned now with acute infections of nervous system, especially poliomyelitis.)

Health Inventory[1] (The field aspects of this study, referred to in preceding numbers of this JOURNAL, have now been completed. The data are being tabulated.)

Heart Disease (Epidemiological studies of rheumatic heart disease.)

Industrial Hygiene (Lead poisoning in storage battery industry; effect of silicate minerals; silicosis; studies of industrial morbidity and mortality statistics.)

Leprosy (Epidemiology of the disease.)

Malaria (Search for new methods of controlling the disease; drainage, ditch maintenance, etc.)

Milk (Municipal milk control survey; advisory assistance to state health departments.)

Public Health Methods (Job analysis of county health departments; cooperative studies with other agencies; etc.)

Statistical Investigations (Prevalence of illness in typical urban and rural communities; recurrent visits to families with chronic diseases; technical supervision of house-to-house canvass, Health Inventory.)

Tick-borne Diseases (Their epidemiology.)

Tuberculosis (Epidemiological studies of the disease in certain regions showing low and high mortality rates.)

OFFICE OF EDUCATION.—*Biennial Survey of Education, 1934–36.* Now that the 1935–36 school year is over, the biennial report forms have been sent to the cities and colleges and are being returned. A preliminary study of income and expenditure data for State degree-granting universities and colleges and about 100 private institutions and the usual Land-grant college preliminary are planned for release in November.

The September issue of *School Life* will have an article on School Survival Rates for the high school classes graduating from 1931 to 1934, and the college classes of 1918, 1932, 1933 and 1934.

[1] Special allotment from Works Progress Administration.

The National Visual Instruction Survey is nearing completion, and the three W. P. A. research projects sponsored by this office, University Research Project, National Survey of Vocational Education and Guidance of Negroes, and the Study of Local School Units, are getting materials in the States which will be coordinated through this office.

NATIONAL RESOURCES COMMITTEE.—*State Section.* In the last three years, State Planning Boards have been established and now exist in all of the 48 states except Georgia and Delaware. Of that number, 32 are on a permanent statutory basis, and the remainder are set up by gubernatorial appointment. Upon meeting certain conditions, the National Resources Committee furnishes to the State Planning Boards the services of a technical Consultant. Research and clerical staff is provided by the Works Progress Administration, by state appropriations and by loans from state departments.

The purpose of State Planning Boards is threefold: (1) inventory of natural and human resources; (2) formulation of master plan for their conservation, utilization, and development; (3) assistance to state government in correlating similar activities of local, state, regional and Federal agencies. Major emphasis in most states is, roughly in order of importance, upon the following: land and water use problems, public works programming, integration of transportation systems, population trends, city and county planning, housing, educational facilities, capacity to produce and consume, recreation, etc. Owing to the lack of funds for printing, copies of several of the State planning reports are not easily obtainable except on loan from the National Resources Committee's Library or from the individual State Planning Boards.

At the suggestion of the National Resources Committee, many State Planning Boards have organized statistical committees to assist in coordinating the Boards' statistical activity with that of other state, Federal and local governmental agencies. Each Board also has a varying number of technical committees representing state departments, universities, civic bodies, prominent citizens, and Federal agencies. Most reports, accordingly, represent the coordinated effort of these different groups.

Water Resources Committee. The Sub-committee on Small Water Storage Projects is initiating a review of unpublished hydrologic data in the files of Federal, state, and local agencies. This work will result in the preparation of an index of available unpublished hydrologic data (precipitation, snow survey, ground-water level, stream-flow evaporation, chemical quality of water, suspended matter in water). The index will indicate the location of the date, their duration and their estimated reliability. At present there are large amounts of data in the files of public agencies which are not readily available to hydrologists, engineers and other technicians wishing to use the data for the design of water conservation structures.

The Advisory Committee on Hydrologic Data has recently completed a report on "Deficiencies in Basic Hydrologic Data." The report reviews the adequacy and inadequacy of established facilities for the collection of hydro-

logic data and recommends specific programs for correction of the more serious deficiencies. It contains also the first complete inventory of these data-collecting facilities maintained wholly or in part by the Federal Government. Tables and maps show the location of an administrative responsibility for the maintenance of rain gages, snow surveys, observation wells, stream gages, evaporation pans, and quality of water sampling stations.

Committee on Urbanism. One part of the statistical activities of the Research Committee on Urbanism has been devoted to trying: (1) To analyze the social problems of cities by the types of cities, the ages of the cities, and the character of their governments, and by various other general characteristics. (2) To tabulate the incidence of certain problems such as unemployment, dependency, and insanity in order to compare the cities with a high incidence of such problems to cities of median and low incidence. This comparison will be directed toward an understanding of the concomitant phenomena.

In order to make this study, it was necessary to divide the work into several sections. Attempts have then been made to follow a uniform classification of the data to permit comparisons. A card was prepared for each city under each item of the classification. The cards were classified by states and census regions to indicate: (1) The population in 1910, 1920, and 1930. (2) The particular size group to which the city belonged in 1930. The size groups used are those established for urban areas by the U. S. Census. (3) How long the city has been in existence as a city, grouped by the age of the city according to whether the city was "old," "average," or "recent." (4) The percentage rate of population growth from 1920 to 1930. (5) The percentage rate of population growth from 1900 to 1930. (6) The metropolitan region, if any, to which the city belongs. (7) The age composition of the population. Three groups were used: all persons under 20 years of age; persons from 20 to 45 years of age; and all persons 45 years and older. (8) The sex ratio of the population, that is, the number of males per 100 females. (9) The nativity of the population by percentage of native born irrespective of race or color. (10) The racial characteristics of the population expressed as a percentage of the white population to the total population in 1930. (11) The percentage of the population gainfully employed in manufacturing industries. (12) The type of government in the city. (13) Unique characteristics of each city.

It is expected these data will be mapped upon a regional basis to make visual the problems presented. Studies are being made of social problems in cities and of organized groups and activities in urban life such as lodges, associations, and credit unions. These data are being collected by states. Other sections of this part of the study deal with the rural free delivery, telegraph and telephone communication, daily newspapers and periodicals, motion pictures, radio, etc. Still other parts deal with the problems of health, crime, recreation, etc.

It is expected that the statistical data upon all these subjects will be arrayed and studies made of the high, median, and low groups. If time is

available, individual cities which present unusual problems, or combinations of problems, will be singled out for separate study.

DIVISION OF PLACEMENT AND UNEMPLOYMENT INSURANCE, NEW YORK STATE DEPARTMENT OF LABOR.—A Division of Placement and Unemployment Insurance has been created in the New York State Department of Labor. This new Division has absorbed the existing State Employment Service which will be expanded to provide the basis for the field service of the merged organization. With reference to its placement activities the new Division is affiliated with the U. S. Employment Service. The Unemployment Insurance Law has been approved by the Social Security Board.

The statistical work of the new Division is a joint responsibility of the Bureau of Research and Statistics and the Bureau of Insurance Control. Current reports from employers and operating reports from the employment offices are received and tabulated by the Bureau of Insurance Control, in accordance with plans and procedures developed jointly by the two Bureaus. The rough tabulations, when completed, will be submitted to the Bureau of Research and Statistics which will prepare final releases for internal use or for publication, and which will be responsible for interpretations and analyses.

The statistical materials of the Division will comprise the payroll and employment statistics derived from employer reports, other records relating to unemployment insurance, and the current reports of placement activities. In addition to the Division's internal statistics, the research staff will of course utilize statistical data from other sources, in measuring trends of employment and unemployment, in forecasting the probable burden on the insurance fund, and in special studies required for the administration of the Law.

The Labor Law of New York State vests responsibility for the administration of unemployment insurance and the conduct of the employment services in the Industrial Commissioner of New York State, Elmer F. Andrews. Glenn A. Bowers, formerly Director of Research of the Industrial Relations Counselors, Inc., has been appointed Executive Director of the Division of Placement and Unemployment Insurance. Harry K. Herwitz, formerly executive officer of the Men's Clothing Code Authority, National Recovery Administration, has been appointed Director of Insurance Control in the Division.

Bureau of Research and Statistics: Meredith B. Givens, until recently secretary to the Committee on Industry and Trade, Social Science Research Council, has been appointed Director of Research and Statistics with the Division. From July, 1933, to January, 1936, Dr. Givens was a member of the Central Statistical Board, and served as executive secretary of the Committee on Government Statistics and Information Services sponsored by the American Statistical Association and the Social Science Research Council. Under his direction the staff of the Bureau of Research and Statistics is being recruited under State Civil Service regulations, to meet the needs of expanding work.

The Bureau of Research and Statistics is located at the metropolitan office of the Division, at 342 Madison Avenue, New York City. The statistical records are located partly at the metropolitan office and partly at the headquarters office in Albany.

An early major task of the Bureau has been the preparation of an *industrial classification plan* to be applied in connection with the assignment of employers' registration numbers. This work has been done in consultation and in full cooperation with the several interested bureaus of the Social Security Board, the U. S. Bureau of Labor Statistics, the Central Statistical Board, the Committee on Economic Security of the Social Science Research Council, and other agencies. The plan provides for the identification of a limited number of major industry groups by means of two digits in the employers' registration number, more detailed statistical groupings to be provided within the office. Preliminary classification indexes covering more than 8,000 industry designations have been prepared by means of experimental classification of a large number of employer returns. The employer returns have now been coded in accordance with this classification plan. This procedure, and other phases of procedure as they develop, will be reduced to manual form by the Division.

An elaborate *Economic Brief* was prepared by the Bureau, in connection with the defense of the Unemployment Insurance Law in the New York State courts.

A *research library* and a *statistical laboratory* have been initiated in conjunction with the work of the Division, and files of basic statistical data obtainable from other agencies are being assembled.

The Bureau has had invaluable assistance from Dr. C. A. Kulp and Dr. Leonard Adams of the Committee on Economic Security of the Social Science Research Council, whose services have been loaned during the preliminary period of work, specifically in connection with the preparation of the *Economic Brief* in support of the Unemployment Insurance Law, and in the experimental work on industrial classification.

DOMINION BUREAU OF STATISTICS, CANADA.—*1936 Census of the Prairie Provinces.*—The Quinquennial Census of the Prairie Provinces of Canada taken, by statute, five years after each decennial census was taken on June 1st, 1936. Early returns have been received, and it is expected that all census returns will be in by July 15th. A preliminary report on the population is expected to be ready by August 1st.

Reports. The Report on the Conference on Agricultural Statistics, held in the Dominion Bureau of Statistics on March 30–31 and April 1–2, and attended by Dominion and Provincial Government Officials and representatives from many parts of Canada and from the United States, has recently been published by the Agricultural Branch. This was the first conference of its kind held since 1924 and covered the whole range of agricultural statistics and their presentation.

NATIONAL BUREAU OF ECONOMIC RESEARCH.—Dr. Joseph H. Willits, a member of the Board of Directors since 1927 and its present Chairman, has accepted the position of Executive Director of the National Bureau. In so doing, Dr. Willits continues to serve as Dean of the Wharton School of Finance and Commerce at the University of Pennsylvania, spending part of his time at the National Bureau. The office of Executive Director is a newly created one, and Dr. Willits will be active in furthering the program of co-operative research initiated by the National Bureau last year. As a center for this program, 'Hillside,' a property in Riverdale-on-Hudson to which the National Bureau has acquired title, will be used.

Two publications of the National Bureau appeared during the summer. *Ebb and Flow in Trade Unionism*, by Leo Wolman, presents recent figures on membership in trade unions, in part the result of special compilations. Dr. Wolman traces the major changes in the extent of labor unionism since his preceding volume on the subject, *Growth of American Trade Unions, 1880–1923*, and gives an analysis of its present status.

Also published was *Bulletin 60:* "Measures of Capital Consumption, 1919–1933," by Solomon Fabricant, an interim report of the study of consumption of capital since the War. It is restricted to the consumption of business capital and presents annual measures, corrected and uncorrected for price changes. *Bulletin 61*, "Production during the American Business Cycle of 1927–1933," by W. C. Mitchell and A. F. Burns, is in press.

Those interested in Dr. Mitchell's second volume—*Business Cycles: Analysis of Cyclical Behavior*—will be glad to learn that mimeographed copies of the third chapter are now available on special order.

Manuscripts of two forthcoming books are in the hands of the printer: Dr. Macaulay's *Some Theoretical Problems Suggested by the Movements of Interest Rates, Bond Yields, and Stock Prices in the United States Since 1857*, and Dr. Mills' study of prices and the price system during recession and recovery. Dr. Mills considers his report more in the nature of a monograph which contributes to an understanding of recent economic movements than as a definitive study of the behavior of prices during the depression and recovery. He follows out certain of the analyses begun in *Economic Tendencies* and carried forward in briefer form in several *Bulletins* issued in the interval.

WHARTON SCHOOL OF FINANCE AND COMMERCE, UNIVERSITY OF PENNSYLVANIA.—The Industrial Research Department is cooperating with the National Research Project of the Works Progress Administration under the direction of Mr. David Weintraub in the making of the annual spring survey of employment and unemployment in Philadelphia. Dr. Gladys L. Palmer of the Industrial Research Department is in charge of the survey and also of the study of job openings and applicants at the Philadelphia State Employment Office. The latter study is a continuation of a series conducted by Dr. Palmer since 1931. These studies constitute part of a general survey

of recent trends in the Philadelphia labor market. The field work will be completed by the end of the summer and the reports published next spring.

The Industrial Research Department of the Wharton School of the University of Pennsylvania has been appointed as the research agency to conduct the study of "Production and Distribution in the Textile Industry," the financing of which was recently authorized by the Textile Foundation. The work will be done in cooperation with the committee on Economic Research of the United States Institute for Textile Research and an auxiliary committee composed of presidents of several of the major textile associations. Joseph H. Willits, Dean of the Wharton School, will be in general charge of the study and will be assisted by the following members of the Industrial Research Department:—C. C. Balderston, Professor of Industrial Management, Anne Bezanson, co-director of the Department, H. S. Davis, in charge of the wool section, and George W. Taylor, in charge of the hosiery section. Mr. Davis will serve as secretary of the group. Other members of the Department and of the School will be called upon to participate in particular phases of the study.

Mr. H. S. Davis, in charge of research in the wool textile industries for the Industrial Research Department has been cooperating with the Bureau of the Census in revising their monthly reports on raw wool consumption, and wool machinery activity.

NATIONAL INDUSTRIAL CONFERENCE BOARD.—The National Industrial Conference Board has in preparation a study of *Private Long-Term Debt in the United States* and a volume on *Wages in the United States, 1914–35*, which will parallel a volume on the cost of living now in press. The volume on wages will assemble in one place the results of the Board's inquiries during 1935 and will give a complete statement of all of its inquiries since they were initiated in 1920 including comparisons in 1914.

The following publications are in press and will be issued soon:

International Transactions of the United States. An exhaustive analysis of the procedure followed in computing the balance of international payments. An examination of existing figures and the presentation of a new estimate of the varied elements that enter into the balance of international payments.

National Income and Its Elements. A comprehensive study of the problems of estimating the national income and the presentation of the results of the Board's study of national income in the years 1929 to 1934.

Savings Plans and Credit Unions in Industry. A study based on a consideration of general practice and the result of an extensive questionnaire inquiry.

The Cost of Living in the United States, 1914–35. This volume will contain, besides the figures for 1935 not heretofore published in book form, a complete statement of the results of the inquiries that have been conducted by the Board over a number of years into the cost of living.

The following studies have been issued by the National Industrial Conference Board between January 1 and July 1, 1936:

219. *The Townsend Scheme.* An analysis of what the plant proposes, how it is expected to operate, and a study of the probable economic effects of the scheme.

220. *Women Workers and the Labor Supply.* A statistical analysis of data regarding women in occupations, derived mainly from the census records, together with a discussion of the available data regarding the apparent effects of the depression on the employment of men and women, respectively.

221. *What Employers Are Doing for Employees.* A study, on the basis of a questionnaire widely distributed by the Board, of the prevalence of the various types of advantages offered to employees that are comprised under the general head of industrial relations activities.

222. *A Statistical Survey of Public Opinion Regarding Current Economic and Social Problems as Reported by Newspaper Editors in the First Quarter of 1936.* A tabulation of returns received by the Conference Board from 3,685 newspapers and farm journals in the United States, representing a total circulation of 17,544,500. Some thirty or more distinctive economic and social problems were submitted to these editors, who were requested to state whether the prevailing opinion in their localities favored or disapproved each specific measure.

223. *Cost of Government in the United States, 1933–35.* A continuation of the previous studies of the Board on the cost of government. These publications have had wide acceptance through the fact that the data and estimates given relate, not to the Federal Government only, but to all governments in the United States including state and local governments. The greater part of the general data on expenditures, tax collections, and debt give figures separately for Federal, for state, and for local governments.

224. *American Agricultural Conditions and Remedies: A Preliminary Survey.* A brief analysis of agricultural conditions in four chapters: I. The American Agricultural Picture today; II. The Measurement of Agricultural Conditions; III. Past Attempts to Help Agriculture; and IV. Positive Programs for Agricultural Improvement.

INSTITUTE OF MATHEMATICAL STATISTICS.—Professor R. A. Fisher of the University of London is among the scholars whom Harvard University is inviting as lecturers in connection with its Tercentenary. Professor Fisher will give a "Harvard Tercentenary Conference Lecture" on the subject: "Uncertain Inference," before a joint session of the American Mathematical Society, Mathematical Association of America, and the Institute of Mathematical Statistics on August 31.

DR. OTTO NEURATH, economist, of Vienna, whose work in the visual portrayal of statistical data has attracted much attention in this country,

will spend three or four months in the United States in the autumn. He will come as the guest of a hospitality committee of which Dr. Alvin Johnson, Director of the New School for Social Research, is chairman. Several organizations are joining in preparations for his visit, including the Oberlaender Trust, the National Tuberculosis Association, the Vocational Adjustment Bureau for Girls, the International Industrial Relations Institute, and Pictorial Statistics, Inc. The purpose of Dr. Neurath's visit will be to make a study of the potentialities in the development of visual education in this country. Plans are also being considered for him to give special instruction of a technical character to those interested in studying what has come to be known as the Vienna method of statistical visualization. The International Foundation for Visual Education, of which Dr. Neurath is Director, and which has its headquarters at The Hague, provides the auspices for this work in several countries. The Institute's forwarding address in the United States is in care of the International Industrial Relations Institute, Room 600, 130 East 22nd Street, New York.

MALCOLM CHURCHILL RORTY

COLONEL MALCOLM CHURCHILL RORTY, former President of the American Statistical Association and for many years a dynamic and influential leader in its activities, died of a heart attack on January 18, 1936.

Colonel Rorty was born in Paterson, N. J., in 1875. He attended Walkill Academy, Middletown, N. Y., and was graduated from Cornell University in 1896 with degrees in mechanical and electrical engineering. Entering the employ of the New York Telephone Company shortly thereafter as a telephone installer, he began a career in the various companies of the Bell System which continued over a period of 27 years.

Granted a leave of absence for military service when America entered the World War, Mr. Rorty was assigned to the Interallied Munitions Council with the task of directing the procurement and shipment of ammunition. Later, as an officer of the General Staff, he took part in active service in the Meuse-Argonne offensive retiring at the close of the war with the rank of Lieutenant Colonel.

Upon his return to civil life in 1918, Colonel Rorty was appointed Chief Statistician of the American Telephone and Telegraph Company. Three years later he was made Vice President of the Bell Telephone Securities Company, returning the following year to the American Telephone and Telegraph Company as Assistant Vice President. In 1924 he resigned from the Bell organization to accept appointment as Vice President of the International Telephone and Telegraph Corporation, which position he held until he became Vice President of the American Founders Corporation in 1930.

Despite Colonel Rorty's announced retirement from active business life in 1931, demands for his services as an industrial and economic expert continued during the depression years and he was summoned as a consultant in many problems of financial reorganization. In May, 1934, he was elected President of the American Management Association and served illustriously in that capacity until his death.

Possessed of boundless energy, a wide range of knowledge, an imagination of rare breadth, and a readiness to subject his hypotheses to the most rigorous tests, Colonel Rorty left a deep impress upon every organization and activity with which he came in contact. His flair for the scientific method is manifested by his having written, early in his telephone experience, a mathematical treatise on "The Application of the Theory of Probability to Traffic Problems," regarded by Bell System engineers as the pioneer contribution to this field. With the later extension of his interests into broader fields of industrial operation and financial policy, his work continued to be characterized by great zeal for sound methodology and an adequate factual basis.

In 1917, Colonel Rorty became a member of the American Statistical Association and two years later, as Chairman of the Committee on Business Statistics, began his noteworthy efforts to promote interest on the part of

business executives and trade association authorities in the more extensive compilation and prompt publication of statistics of physical production in the manufacturing industries. This work bore immediate fruit, not only in increasing the volume of data available for economic analysis, but also in vastly broadening the interests of the Association itself and aiding to bring within its membership the leaders of the then relatively new and rapidly expanding profession of business statistician.

In 1921, Colonel Rorty was elected a Fellow, and in 1922 a Vice President, of the Association. His vision and inspiring leadership played an important part in the founding of the National Bureau of Economic Research in 1924, and from that date continuously until his death he was a member of the Board of Directors of the Bureau by appointment from the Association, serving also from time to time as its treasurer, president and chairman of the board. In recognition of his contributions to the field of statistics and economic research, the American Statistical Association elected him as President for the year 1930. His administration was marked by substantial progress, not only in the scope and content of its annual and regional meetings, but also in membership growth and the strengthening of its internal organization. Subsequently he served for two years as a member of the Board of Directors and for two years as a member of the Finance Committee. At the time of his death he was a member of the Committee on Fellows.

In the field of published material, Colonel Rorty was perhaps best known for the pungent and thought-provoking notes which he contributed at frequent intervals to this JOURNAL and other periodicals. Among his longer contributions may be mentioned a book on "Some Problems in Current Economics," published in 1922; a paper on "The Necessity for Wage Reductions in the Present Crisis," published in the *Proceedings of the Academy of Political Science* (1932); and the following three papers which appeared in the *Harvard Business Review:* "The Statistical Control of Business Activities," (1923); "How May Business Revival be Forced," (1932); and "The Equation of Economic Balance," (1934).

Warm hearted and sympathetic in his human relations, eager in his loyalties, always stimulating and often provocative in his arguments, Colonel Rorty had a genius for making friendships that will long be treasured by those who knew him best. As a statistical worker, his philosophy and habits of thought are perhaps best portrayed in his Presidential Address at the ninety-second annual meeting of the Association, published in the March, 1931, issue of this JOURNAL. The concluding sentences of this address are particularly self-revealing:

> The statistician, as the chief pathfinder among scientific pioneers, must necessarily combine that vision which comes from fertility, breadth, and incisiveness of hypothesis, with the balance and sureness of step of the scientific method as a whole. But, above all, he must possess something of the rude spirit of the frontiersman and must seek his results in every legitimate way, regardless of refinements of method and rigidity of conventions.

DONALD R. BELCHER

NEW MEMBERS

Adamson, Wendell M., Statistician, Bureau of Business Research and Instructor in Statistics, Box 1973, University of Alabama, University, Alabama

Allen, Harland H., President, Harland Allen Associates, 10 South LaSalle Street, Chicago, Illinois

Asofsky, Abraham A., Junior Accountant, Federal Communications Commission, Room 1612, 195 Broadway, New York City

Bershad, Max A., Assistant Statistician, Room 255, Treasury Building, Washington, D. C.

Brooks, Alvin G., Inspection Engineer, Western Electric Company, Hawthorne Plant, Cicero Avenue and Cermak Road, Cicero, Illinois

Burch, Dr. Mary C., Associate Professor of Psychology, Mills College, Mills College, California

Callahan, Joseph A., Statistician, Petroleum Trade Association, 50 West 50th Street, New York City

Corstvet, Emma, Assistant Professor, Yale Institute of Human Relations, 410 Riverside Drive, New York City

Davies, Evan G., Statistician, Retail Research Association, Controllers Division, 1440 Broadway, New York City

Dennis, Samuel J., Associate Research Assistant, Central Statistical Board, 7028 Commerce Building, Washington, D. C.

Fish, Mrs. Willis E., Abington Hotel, 700 Seward Avenue, Detroit, Michigan

Funkhouser, Richard L., Assistant Statistician, Central Statistical Board, 7028 Commerce Building, Washington, D. C.

Gill, Samuel E., Director of Research, Crossley, Inc., 330 West 42nd Street, New York City

Goddard, Oliver E., National Aniline & Chemical Company, 40 Rector Street, New York City

Grobben, Margaret, Research Worker, Consumer Credit Institute of America, 1158 Woolworth Building, New York City

Handy, Uvan, Research Associate, c/o Dr. Theodore F. Lentz, Box 145, Washington University, St. Louis, Missouri

Hellborn, Ludwig S., Research Assistant, Central Statistical Board, 7028 Commerce Building, Washington, D. C.

Hines, Samuel M., Teaching Fellow, Box 161, University of North Carolina, Warsaw, North Carolina

Hoos, Sidney S., Administrative Statistician, Maine Works Progress Administration, 142 High Street, Portland, Maine

Kiefer, Earle A., Jr., Economist, State-Wide Highway Planning Survey, North Dakota State Department of Highways, 18th Floor, State Capitol Building, Bismarck, North Dakota

Kossoris, Dr. Max D., Senior Statistician, Bureau of Labor Statistics, Department of Labor, Washington, D. C.

Larson, Dr. Selmer C., Head of Mathematics Department, State Normal School, Oswego, New York

Lowery, Dave, Research Assistant, Coordinating Committee, Central Statistical Board and Works Progress Administration, Washington Auditorium, Washington, D. C.

MacNeil, Douglas H., Manager, Research Division, State of New Jersey Emergency Relief Administration, 20 Washington Place, Newark, New Jersey

Magdoff, Harry S., Associate Statistician, Works Progress Administration, Room 717, 12 South 12th Street, Philadelphia, Pennsylvania

Mason, Jacob H., Supervisor of Statistical Unit, Research and Compilation Internal Revenue, Income Tax Unit, Bureau of Internal Revenue, Department of the Treasury, Washington, D. C.

Melchiorre, Joseph, Draftsman, Valuation Department, Pennsylvania Railroad Company, 15 North 32nd Street, Philadelphia, Pennsylvania

Mode, Elmer B., Professor of Mathematics, Boston University, 688 Boylston Street, Boston, Massachusetts

Moore, Frances A., Associate Social Statistician, Division of Public Assistance Statistics, Bureau of Research Statistics, Social Security Board, Washington, D. C.

Mummery, Charles R., Section Head, Cleaner Research Section, Engineering Department, The Hoover Company, North Canton, Ohio

Neiswanger, Don M., Manager, Statistics and Research Department, The New York, New Haven & Hartford Railroad Company, Room 403, General Office Building, New Haven, Connecticut

Nichols, Dr. Irby C., Professor of Mathematics, Louisiana State University, 915 St. Hypolite Street, Baton Rouge, Louisiana

Ogan, Dr. Ralph W., Dean of the College and Professor of Education, Montgomery Hall, Muskingum College, New Concord, Ohio

Post, Harold L., 512 Ontario Avenue, Sheboygan, Wisconsin

Raver, Dr. Paul J., Associate Professor of Public Utilities, Northwestern University, and Chief, Section Rates and Research, Illinois Commerce Commission, 1 North LaSalle Street, Chicago, Illinois

Reed, Dr. Spencer H., Special Agent, Works Progress Administration, Garfinckel Building, Washington, D. C.

Riley, Donald C., Research Assistant, Central Statistical Board, 7028 Commerce Building, Washington, D. C.

Roos, Dr. Charles F., Director of Research, Cowles Commission for Research in Economics, 301 Mining Exchange Building, Colorado Springs, Colorado

Shaul, John R. H., Senior Statistical Investigator, Southern Rhodesian Government, Box 791, Salisbury, Southern Rhodesia, Africa

Siegel, Irving H., Research Assistant to Dr. W. I. King, Room 530, School of Commerce, New York University, Washington Square, New York City

Siegel, Seymour N., Assistant Director of Broadcasting for the City of New York, Department of Plant and Structures, 1800 Municipal Building, New York City

Simon, Leslie E., Captain, Ordnance Department, United States Army, Picatinny Arsenal, Dover, New Jersey

Sims, Lewis B., Member research staff, Central Statistical Board, 7028 Commerce Building, Washington, D. C.

Slomowitz, Martin, 23 Harding Terrace, Newark, New Jersey

Smith, Mabel A., Statistician, Case Pomeroy & Company, 120 Wall Street, New York City

Springer, John Y., Instructor, Economics Department, Stanford University, Stanford University, California

Stilwell, F. Richard, Research Assistant to the Dean, School of Social Work,

Catholic University of America, 1441 Rhode Island Avenue, N. W., Washington, D. C.

Thompson, R. L., Statistician, City Planning Commission of Minneapolis, City Hall, Minneapolis, Minnesota

Tobias, George, Unit Chief and Assistant Statistician, Works Progress Administration, Washington Auditorium, Washington, D. C.

Tower, Dr. Ralph B., Professor of Economics, Mt. Union College, Alliance, Ohio

Turnbull, Alan, Jr., Senior Statistician in charge of Research Unit, Pennsylvania State Emergency Relief Administration, 147 North Cameron Street, Harrisburg, Pennsylvania

Unterberger, S. Herbert, Senior Research Assistant, Works Progress Administration, 12 South 12th Street, Philadelphia, Pennsylvania

Williams, Mrs. Jean H., Junior Research Assistant, Central Statistical Board, 7028 Commerce Building, Washington, D. C.

Winston, Dr. Clement, Associate Statistician, Works Progress Administration, Room 717, 12 South 12th Street, Philadelphia, Pennsylvania

Yoder, Dr. Dale, Professor of Economics and Personnel Administration, University of Minnesota, Minneapolis, Minnesota

Young, Dr. Erle Fiske, Professor of Sociology and Social Work, School of Social Work, University of Southern California, Los Angeles, California

REVIEWS

Length of Life, A Study of the Life Table, by Louis I. Dublin and Alfred J. Lotka. New York: The Ronald Press. 1936. xxii, 400 pp. $5.00.

Once more Dr. Dublin and Dr. Lotka have put the statistical world in their considerable debt, for the present work is a valuable and useful addition to the available literature on human life duration. It will prove useful both for reference and for teaching. The typographical arrangement of the book suggests that the latter objective was definitely and purposefully in the minds of the writers, as does also the evident pains taken to explain with the utmost clarity and simplicity the various technical steps taken in the development of their argument and of their material. As was to be expected from such accomplished literary technicians, the whole book is a model of lucid exposition of an inherently complicated and difficult subject.

The book is developed around the life table, as the subtitle implies. A few pages of general introductory matter about human longevity in general include an account of Christen Jacobsen Drakenberg, a Danish sea-faring man reputed to have lived just a few days short of 146 years, in the 17th and 18th centuries. That was a long time ago—as a current ribald drinking song so effectively emphasizes—and at least one hardened sceptic ventures to doubt the alleged record, even though the authors seem disposed to regard it indulgently because it has been seriously discussed in the highest-toned of actuarial journals.

After the brief introduction the authors present two new life tables that they have computed (one for males and the other for females) to represent the mortality conditions prevailing in the United States, excluding Texas and North Dakota which were not in the Registration Area in 1929, over the three-year period 1929–1931 centering about the date of the last census. The meaning and mode of derivation of each item in these life tables are discussed in detail and with exemplary clarity. In fact I do not know of any place in the literature where the detailed anatomy of a life table is so beautifully and adequately described. The only possible criticism that could be offered is that in this chapter of the book, in direct connection with the informing of the reader of the nature of life tables derived from general population data, it might have been desirable if the authors had devoted a separate section to an equally clear exposition of the peculiarities and limitations of life tables derived from other sorts of data, such as life insurance experience, the complete following through of each individual life from birth to death which is possible with lower organisms, etc. In this way it would have been possible to make it perhaps clearer just what postulates and assumptions are implicit in the general population type of life table compared with other types. To be sure, there is a chapter towards the end of the book on insurance life tables, but even that does not seem to bring out the point under discussion with quite the clarity and emphasis that might be desired.

But, after all, this is a sin of omission only, if a sin at all, and no great weight is to be attached to it.

The next chapter deals with the life table as a record of human progress and reaches the conclusion that there was a gain of 10 or more years in average length of life in the more progressive countries during the 19th century, and that this was not due to any significant change in the inborn characteristics of the human material itself but rather to more civilized living and better knowledge of methods of controlling disease. To the gains in life expectation of the population of the United States a separate chapter is devoted. The results are gratifying but not in principle different from those already noted.

A chapter on geographic distribution of longevity in the United States discusses penetratingly the question of comparative urban and rural mortality rates and presents a particularly striking table in which death rates attributed to cancer on the one hand, and to senility, ill-defined and unknown causes combined on the other, are presented in parallel columns by state, indicating some part of the considerable effect that faulty registration practice may have upon apparent urban-rural differences. There then follow three chapters on various biological aspects of the life table, the first two making a valuable analysis of the mortality curve into components attributable to particular causes and groups of causes, and the third reviewing the present status of knowledge regarding the inheritance of longevity. The increase of mortality from heart diseases in 1930 over 1920 is attributed in part to greater survivorship from other hazards of earlier life. A long chapter on the contribution of medical and sanitary science to longevity ends with a hypothetical life table that speculatively predicts what further progress in life expectation may be attainable. It puts the expectation at birth at approximately 70 years. The assumptions made in the construction certainly do not seem unreasonable, and there is none of the silly nonsense, that some less acute writers have indulged in, about a prospective lengthening of the life span.

Physical impairments and occupation in relation to longevity are discussed in the next two chapters, mainly by way of review. A long and superb chapter on the life table in relation to population problems is an outstanding feature of the book. It is based upon and in part embodies some of the highly original and epoch-marking investigations of the junior author in particular in the field of population theory. The remainder of the volume is devoted to matters of special interest to those working in the field of life insurance and to detailed instructions for the computation of a life table from population data.

Altogether this is a notable contribution that no human biologist, statistician, actuary, or public health worker will fail to read and preserve on his library shelves.

RAYMOND PEARL

The Johns Hopkins University

Family Expenditure: A Study of its Variation,* by R. G. D. Allen and A. L. Bowley. London: P. S. King and Son, Ltd. 1935. viii, 145 pp. 9 s.

This study of variations in family expenditures presents an interesting and valuable example of the possibilities of mathematical analysis in the field of consumption. The volume is divided into four quite distinct sections. The first chapter analyzes data from 21 different studies of family expenditures with techniques made familiar in this country by W. F. Ogburn in his analyses of data collected by the U. S. Department of Labor in the District of Columbia in 1916 and in 91 different cities in 1917–19.[1]

The second chapter presents an original contribution to the techniques of measuring variations in family expenditures by analyzing the differences between the actual expenditures of individual families and the expenditures which would be expected on the basis of regression equations expressing the average behavior of their group. The third chapter is devoted to a theoretical analysis of the distribution of expenditure which develops theses, presented by one of the authors with Mr. J. R. Hicks in *Economica*.[2] The fourth section, the appendix, sets forth the mathematical basis for the third chapter. The third and fourth sections, which represent about one-third of the volume, build upon the work of Edgeworth and Pareto and seek to develop theories of the marginal rate of substitution for competitive consumers' goods.

The volume is somewhat marred by the looseness with which it uses certain economic terms. For example, the term "total income" is not infrequently used interchangeably with "total family expenditures for consumer goods and services," whether paid for out of current income, from savings, or from borrowings. References in the text to data for New York state farm families, supplied by Canon (p. 79), would lead one to believe that figures on the food expenditures of these families might include money value of food produced by these families for their own consumption, but there is nothing in either text or tables to explain how home-produced food has been treated. The authors follow the continental usage and restrict the term "workers" to wage earners, "workers" being contrasted with "salaried employes" and "officials," an unsound, if not a dangerous distinction.

In the first chapter of the book, the authors use the results of 19 studies made in Europe from 1904 to 1932 and of two made in the United States, the 1917–19 study of the United States Department of Labor and that made by Canon among the central New York farm families in 1928–29. Their first

* *Review Editor's note:* Because of the nature and importance of this book, reviews from two points of view were arranged for.

[1] Ogburn, William F., "Analysis of the Standard of Living in the District of Columbia," *Quarterly Publications of the American Statistical Association*, vol. 16, 1919, pp. 374–389.

Ogburn, William F., "A Study of Food Costs in Various Cities," U. S. Department of Labor, Bureau of Labor Statistics, *Monthly Labor Review*, vol. 9, no. 2, 1919, pp. 1–25.

Ogburn, William F., "A Study of Rents in Various Cities," U. S. Department of Labor, Bureau of Labor Statistics, *Monthly Labor Review*, vol. 9, no. 3, 1919, pp. 9–30.

Ogburn, William F., "The Financial Cost of Rearing a Child," U. S. Department of Labor, Children's Bureau, *Standards of Child Welfare*, pp. 26–30. 1919.

[2] Hicks, J. R. and Allen, R. G. D., "A Reconsideration of the Theory of Value." *Economica*, n.s. 1. pp. 52–76, 196–219. London, 1934.

purpose is to discover whether family expenditures on various items bear linear or other relations to total expenditures. An analysis of average expenditures for groups of items, shown by these 21 studies, leads them to conclude that there is "a good fit, allowance being made for observation and sampling errors and for imperfections in the data, to a linear expenditure relation, and occasionally to a parabolic relation" (p. 123). They point out, however, that the linear law is only a first approximation and that it is only a close fit over the central range of incomes and may easily cease to apply at low or high incomes (p. 14). This chapter includes a discussion of index numbers of living costs, emphasizing the fact that "an index of the cost of living based on average expenditure is only applicable to families whose expenditure is near the average." The authors illustrate the familiar fact that the level of an index number depends on the relative weights given to its component sub-indexes for food, rent, fuel, light, and so on, as well as on the level of the sub-indexes. With the use of indexes computed by the British Ministry of Labour on the average cost in January, 1935 (base July, 1914) of the various *groups* of items purchased by British wage earners, and regression equations based on a study of wage earners' expenditures, they show how new indexes of living costs may be computed for any income level higher or lower than the average. The indexes thus calculated are 129 for the low expenditure family and 150 for the high expenditure family. They may be compared with 143 for the average family, as computed by the Ministry of Labour (p. 17). The authors point out that "These results would, of course, be somewhat modified if the computation was carried out in full detail." The difference between the indexes computed for the low expenditure family and the high expenditure family, 16 per cent, is very much greater than those secured in the United States by the Department of Labor, and by the Heller Committee for Research in Social Economics in computing similar indexes although with a narrower expenditure range. The BLS index[3] of living costs of custodial employes living in Washington with basic salaries under $2,500 (average total expenditures $1,989) for November, 1934, was 85.6 in comparison with 100 for the first six months of 1928; for employes with basic salaries over $2,500 (average total expenditures $4,114), the index was 87.3, a difference of 2 per cent. The Heller Committee[4] index for wage earners in San Francisco was 81.9 for November, 1935, in comparison with 100 in 1929 (average expenditures $2,379) and for executives, 83.9 (average expenditures $7,179), a difference of 2.4 per cent.

The relatively large differences in the index numbers for workers with expenditures of one-half the average expenditure and twice the average expenditure ($\frac{1}{2}\bar{e}$ and $2\bar{e}$), computed by Allen and Bowley, may be explained by a number of different factors. The group indexes used in their computations

[3] United States Department of Labor, Bureau of Labor Statistics. "Cost of Living in the United States and Foreign Countries," *Monthly Labor Review*, vol. 40, no. 2, Feb. 1935, p. 531.

[4] Heller Committee for Research in Social Economics. *Quantity and Cost Budgets for (1) Family of an Executive, (2) Family of a Clerk, (3) Family of a Wage Earner, (4) Dependent Families or Children, Prices for San Francisco*, November, 1935, University of California, Berkeley, California, February, 1936.

represent changes in costs in Great Britain from July, 1914, to November, 1935, and the weights represent British experience in 1904. The regression equations used to compute indexes for families with expenditures of $\frac{1}{2}\bar{e}$ and $2\bar{e}$ come from a German study of 1927–28. The authors may be mistaken in assuming that a linear relationship between total expenditures and expenditures for specific items other than food would extend over an income range as wide as $\frac{1}{2}\bar{e}$ to $2\bar{e}$. Reweighting group indexes instead of reweighting price ratios for specific commodities would, as the authors point out, always result in a certain amount of error. In view of the possibilities of the misinterpretation of this section, it is unfortunate that it was not further safeguarded.

The analysis is continued with material from investigations for which the authors had available detailed expenditure figures for each of the families in the groups studied: wage earners in Hamburg and Bremen in 1927–28 and in Liverpool in 1929, clerks in English towns in 1926, families from all classes studied by the London School of Economics in 1932, and the New York state farm families studied by Canon in 1928–29. The data from these investigations are used to measure variations of the expenditures of individual families from the linear relationships discovered to be typical for their group. These experiments provide, in the opinion of the present reviewer, the most valuable section of the book.

The equation of linear relationship is developed with the following symbols:

$$\bar{y} = k\bar{e} + c$$

in which $\bar{y}$ equals the average expenditure of the group for a given item, $\bar{e}$ the average total expenditure, and k and c are constants, determined by the least squares method from the data for the entire group. The difference between the observed expenditures of particular families for given items and groups of items and the expenditures expected from the regression lines expressing the average behavior of the group of which this family is a part are called "residual expenditures." Eliminating the effect of differences in total expenditure for the tth family

$$y_t = ke_t + c + v_t \quad \text{and} \quad v_t = y_t - (ke + c)$$

where e_t and y_t are the total expenditures of the particular family and their expenditure on a given item.

A study of the coefficient of variation of these residual expenditures v_t and of the distribution about the average (which is necessarily zero) provides a very valuable test of the homogeneity of certain of the expenditure patterns of the groups considered. For example, the distribution of the residuals computed from the expenditures for rent by clerks in English towns in 1926 in relation to their total expenditures is approximately symmetrical in character with a chi square of only 6+, which indicates a very good fit, as it was calculated on the basis of averages from ten groups of cases.

On the other hand, similar figures collected by the London School of Economics in 1932 from families responding to a broadcast appeal for data on their expenditures provide quite different results. "The families were not homogeneous in social class and they came from various parts of the country. The collection can be taken as largely middle-class and professional but a certain number of definitely working-class families are included" (p. 80). The distribution of the residuals from regression lines of expenditure for rent per equivalent adult for this group is very much skewed and indicates (as is natural) that either the housing conditions or the tastes as regards housing (or both) of this group are far from being homogeneous.

The authors conclude their analyses of variation by pointing out that "These particular results can only establish a presumption that the analysis is applicable. More definite conclusions can only be obtained when budget collections are available with a more detailed classification of items, when more attention is paid to variation of needs, and when we have larger and more homogeneous samples of families" (p. 85). The studies of consumer purchases now under way in the United States will provide such data. So, presumably, will the study shortly to be undertaken in this field by the British Ministry of Labour, since Professor Bowley is a member of the advisory committee which is assisting in planning it.

FAITH M. WILLIAMS

U. S. Bureau of Labor Statistics

Family Expenditure: A Study of its Variation, by R. G. D. Allen and A. L. Bowley. London: P. S. King and Son, Ltd. 1935. viii, 145 pp. 9 s.

This investigation differs from all previous family budget studies in that it is based definitely on some of the preconceptions of modern mathematical theory of utility and exchange. That theory enables us to explain the pattern of consumption of an individual in terms of his tastes, his income, and market prices. Its application to family budget data should yield useful and interesting results.

More specifically, the purposes of this investigation are, in the words of the authors, " . . . to discover how far the expenditures of individual families or of groups of families can be described by rules and formulae, to relate any rules that are found to the postulates of economic theory and to describe the variations from the averages that result from the different choices of individual families" (p. 1).

The theory is severely mathematical in form and is summarized in a mathematical appendix of nineteen pages. It cannot conveniently be condensed further. All that it is possible to give within the limits of a review are (1) the major steps by which the authors reach their most important formula, and (2) the uses to which this formula is put.

Let there be n consumers goods, $X_1, X_2, \cdots, X_n$, and let his tastes be represented by the *function index* of utility

$$u = F\{\phi(X_1, X_2, \cdots X_n)\}, \tag{1}$$

where ϕ is any form of the index and F is an arbitrary function limited only by the condition that $F'(\phi) > 0$. Let the goods be obtainable on a given market at the uniform prices $p_1, p_2, \cdots, p_n$, respectively. At these prices the individual purchases the quantities $x_1, x_2, \cdots, x_n$, so that his expenditure e_r on any good X_r is $e_r = p_r x_r$, his total expended income being:

$$e = x_1 p_1 + x_2 p_2 + \cdots + x_n p_n. \tag{2}$$

The problem is to determine the equilibrium purchases $x_1, x_2, \cdots, x_n$.

If we assume that within the limits of his income the individual purchases that combination of goods which pleases him most, the solution is obtained by maximizing (1) subject to condition (2). The necessary conditions for this maximum are that

$$du = F'(\phi)\frac{\partial \phi}{\partial x_1}dx_1 + \frac{\partial \phi}{\partial x_2}dx_2 + \cdots + \frac{\partial \phi}{\partial x_n}dx_n = 0 \tag{3}$$

and

$$de = p_1 dx_1 + p_2 dx_2 + \cdots + p_n dx_n = 0, \tag{4}$$

the partial derivatives being functions of all the quantities.

The solution may be put in this form:

$$\frac{1}{p_1}\frac{\partial \phi}{\partial x_1} = \frac{1}{p_2}\frac{\partial \phi}{\partial x_2} = \cdots = \frac{1}{p_n}\frac{\partial \phi}{\partial x_n}, \tag{5a}$$

which, together with (2) are equal in number to the n unknown quantities. The economic interpretation of equations (5) is that at equilibrium the marginal utility per "penny's worth" is the same for all commodities.

Equations (5) may also be put in the form:

$$\frac{\partial \phi}{\partial x_1}\Big/\frac{\partial \phi}{\partial x_n} = \frac{p_1}{p_n}, \quad \frac{\partial \phi}{\partial x_2}\Big/\frac{\partial \phi}{\partial x_n} = \frac{p_2}{p_n} = \cdots = \frac{\partial \phi}{\partial x_{n-1}}\Big/\frac{\partial \phi}{\partial x_n} = \frac{p_{n-1}}{p_n} \tag{5b}$$

which expresses the fact that at equilibrium the marginal degrees of utility of any two commodities are in the same ratio as their prices. The geometrical interpretation of (5) is that the equilibrium quantities are the coordinates of the point at which the "indifference loci" (3) are tangent to the hyperplane (2); at that point the slopes of the indifference loci and of the hyperplane are equal to one another.

Now the absolute value of the slope of the indifference locus of the goods X_r and X_s is, by (3),

$$-\frac{\partial x_r}{\partial x_s} = \frac{\partial \phi}{\partial x_s}\Big/\frac{\partial \phi}{\partial x_r}, \qquad (r, s = 1, 2, \cdots, n). \tag{6a}$$

Following Hicks and Allen,[1] the authors define (6a) as "the marginal rate of substitution of X_r for X_s," and designate it as

$$-\frac{\partial x_r}{\partial x_s} = R(x_1, x_2, \cdots, x_n). \tag{6b}$$

[1] J. R. Hicks and R. G. D. Allen, "A Reconsideration of the Theory of Value," *Economica*, XIV (1934), 52–76 and 196–219.

Equations (5b) then become:

$$R_1 = p_1/p_n,\ R_2 = p_2/p_n,\ \cdots,\ R_{n-1} = p_{n-1}/p_n. \tag{7}$$

These equations tell us that the equilibrium purchases are such that the marginal rates of substitution are equal to the price ratios.

By solving[2] (2) and (7) we obtain the individual demand functions for the various goods:

$$x_r = F_r(e, p_1, p_2, \cdots, p_n), \qquad (r = 1, 2, \cdots, n). \tag{8}$$

We have then:

$$e_r = p_r x_r = p_r F(e, p_1, p_2, \cdots, p_n). \tag{9}$$

Each of the demand functions (8) gives the equilibrium position of the individual corresponding to different total expenditures and to different market prices. In family budget series, however, the prices may be taken as constant, or nearly constant, since the studies relate to a given date, or to a comparatively short interval of time, so that (9) becomes:

$$e_r = f_r(e). \tag{10}$$

These are the individual's *expenditure functions*. The form of each function f_r depends on two points—the form of the individual's preference scale R and the level at which the market price happens to be fixed for him. Generally the expenditure on any good X_r increases as total expenditure e increases, but in exceptional cases it can happen that $de_r/de < 0$.

The function R which describes the individual's preference scale is not observable directly, though it is subject to a few general restrictions. It may assume almost any one of an infinite number of forms. For simplicity, the authors assume that it is a linear function of the quantities. Thus in the case of R_1 of equation (7), the assumption is that

$$R_1 = \frac{p_1}{p_n} = \frac{a_1 + a_{11}x_1 + a_{12}x_2 + \cdots + a_{1n}x_n}{a_n + a_{n1}x_1 + a_{n2}x_2 + \cdots + a_{nn}x_n} \tag{11}$$

where the a's are constants. In the case of linear preference scales the authors show that by converting the x's into the corresponding e's the equilibrium conditions (2) and (7) reduce respectively to the forms:

$$e_1 + e_2 + \cdots + e_n = e \tag{12}$$

and

$$\begin{aligned} & b_1 + b_{11}e_1 + b_{12}e_2 + \cdots + b_{1n}e_n \\ &= b_2 + b_{21}e_1 + b_{22}e_2 + \cdots + b_{2n}e_n \\ &= \cdots\cdots\cdots\cdots\cdots \\ &= b_n + b_{n1}e_1 + b_{n2}e_2 + \cdots + b_{nn}e_n, \end{aligned} \tag{13}$$

where

$$b_r = a_r/p_r \quad \text{and} \quad b_{rs} = a_{rs}/p_r p_s, \quad (r, s = 1, 2, \cdots, n).$$

[2] For the explicit form of this solution see Henry Schultz, "Interrelations of Demand, Price, and Income," *Journal of Political Economy*, XLIII (1935), No. 4, 433–481.

Solving this set of n equations for e_r the authors obtain the simple linear form:

$$e_r = k_r e + c_r, \tag{14}$$

where k_r and c_r, which involve the b's, are constant for any individual (or homogeneous group of families), but may differ from individual to individual (or from group to group). If k and c differ, the individuals or the groups in question are not alike with respect to their desire for the given good.

Formula (14), which constitutes the keystone of the authors' theoretical structure, enables them to test Engel's Law. This law states that as income increases the proportions spent on the more urgent needs (such as food) decrease whereas those devoted to luxuries or semi-luxuries increase. Denoting by f the amount spent on any such item as food, the formula becomes:

$$f = ke + c, \tag{15}$$

where k is the slope and c is the intercept of the straight line. If $c>0$, the larger its value the more rapidly does the proportion of expenditure on the item in question decrease as total expenditure increases. If $c<0$, the larger its numerical value, the more rapidly does the proportion spent on the item increase with total expenditure. A commodity is defined as a necessity if $c>0$ and as a luxury if $c<0$. The order of values of c from large plus to large negative value thus fixes the *order of urgency* of the items in the budget.[3]

Armed with this tool of analysis, the authors examine twenty-six family budgets relating to different countries with a view of determining whether the average expenditures on the various items satisfy formula (14) or some other simple equation. Then they analyze certain budget collections for which detailed individual returns are available in order to determine the relation of individual to average expenditure as income changes. They find that, when allowance is made for sampling errors and for imperfections in the data, the average expenditures on various items in the family budget are related to the average income by the simple linear equation (14), although occasionally a parabolic relationship is clearly indicated. The data also show that there is a considerable variation of expenditure about the average of each group but that when allowance is made for the variation of needs and income, the deviations of the individual expenditures about the line of regression can be described, at the first approximation, by the normal law.

The names of the authors are a sufficient guarantee of the excellence of the work. In the opinion of the reviewer, however, the investigation would have been enriched by a comparison of their Engel curves with those contained in the pioneering study by Professor W. F. Ogburn, which was based on more than 2,000 budgets of families living in the District of Columbia in 1916.[4] For the two investigations mutually confirm one another. Ogburn

[3] In their statistical work the authors find it convenient to transpose the origin of the variables to their arithmetic means and to divide the result by e.

[4] W. F. Ogburn, "Analysis of the Standard of Living in the District of Columbia in 1916," *Journal of the American Statistical Association* XVI (1919), 374–389.
Ogburn dealt with 20 variables and gave 37 simple and 18 multiple regressions.

finds that within the observed income ranges the Engel curves are approximately linear; so do Allen and Bowley. Ogburn's regressions show that when allowance is made for the size of the family, the proportions of the total income spent on food, rent, and fuel and light, liquor and tobacco, and sickness decrease as income increases, whereas the proportions spent on clothing, sundries, religion, furniture, education, and amusement increase with income. This conclusion is also in harmony with Allen and Bowley's findings.

The reviewer also wonders whether *as econometricians* the authors have not paid too big a price when they adopted the Hicks and Allen definition of complementarity,[5] for according to that definition two commodities can be related only by way of competitiveness, even though they are salt and soup![6] He appreciates the authors' desire to build an "objective" theory, i.e., one which does not postulate the measurability of utility. But their theory is valid only for an *individual*. To be able to use it in analyzing statistical data, they are compelled to assume that it is also applicable to a *group* of individuals. Since individual indifference curves cannot be aggregated to form the indifference curve of the group except by postulating a utility function for the group, does not the *statistical procedure* of the authors come dangerously close to implying that utility is not only measurable but that the utilities of different persons are comparable? If this interpretation is correct, it is difficult to justify their rejection of the classical definition that two goods X_r and X_s are completing, independent, or competing according as $\partial^2\phi/\partial x_r \partial x_s$ is positive, zero, or negative, on the ground that this definition assumes utility is measurable in the sense that the index of utility F is a linear function of ϕ: $F = A + B\phi$. But since the authors do not apply their definitions of complementarity, this point is not of immediate importance.

Family Expenditure is an important contribution to econometrics. It may very well be that sociologists, psychologists, advertisers, and others who are interested in consumer behavior will have to turn to mathematical economics if they are to understand future researches in this field.

HENRY SCHULTZ

University of Chicago

Studies of Family Living in the United States and Other Countries: An Analysis of Material and Method, by Faith M. Williams and Carle C. Zimmerman. Washington, D. C. United States Department of Agriculture, Miscellaneous Publication No. 223. 1935. 617 pp. 60 cents.

A comprehensive survey of family living studies has been needed urgently for many years, and this report will be useful to students in a wide variety of

[5] See reference in note 1.

[6] For a comparison of different definitions of completing, independent, and competing goods, see Henry Schultz, "Interrelations of Demand, Price, and Income," *Journal of Political Economy*, XLIII No. 4, especially pp. 458–63

fields. Approximately 1,500 studies in 52 countries have been listed, and a short resumé usually running between 100 and 500 words each is given for nearly all the studies. The summaries of the foreign studies are especially valuable, since they bring information of at least a partial character on a field largely inaccessible to the majority of students in this country either because of language difficulty or the impossibility of securing the documents. Miss Williams has been responsible for the material from the United States and Canada and Professor Zimmerman for the material from the other countries.

The studies are arranged in the bibliography according to continents or main geographic regions and alphabetically by countries within the regions. Where countries are represented by more than 50 studies a further subdivision has been made into (1) farm families, (2) families of wage earners, low-salaried workers, and small proprietors, (3) other independent families, and (4) dependent families. Within the groups the studies are arranged chronologically. The index is by authors. In addition to the annotations in the bibliography proper an extensive table indicates the inclusion or omission of important types of material in each of the studies. There are 67 items covered for the studies from the United States and Canada and 39 items for the studies from the other countries. This permits the studies in which certain types of information are available to be readily determined. One may, for example, quickly determine which sources give quantity data concerning food. A similar set of tables cover the methodology followed, 28 items being included for the studies from the United States and Canada and 15 items for the foreign studies.

There are also two excellent general discussions of about 30 pages each included in the volume; the first covers the historical development of these studies and the second is on the methodology employed. Miss Williams prepared the section on the history for the United States and Canada and the statement on the methods of the statistical schools. Professor Zimmerman prepared the section on the history of the studies of family living in other countries and the discussion of the methods of the Le Play school.

One is impressed by the variety of the individual studies and the difficulties of combining them for any aggregate or comparison. Most of the investigations appear to have been made with a special purpose in mind and with little thought of their comparability with other work. In the United States the studies have been restricted largely to the low income groups and farm families, but even here the coverage is incomplete. The authors have not only provided us with an excellent bibliography but in bringing all the material together have performed a service in showing that despite its magnitude the existing information is highly heterogeneous and incomplete.

WARREN C. WAITE

University of Minnesota

Statistical Confluence Analysis by Means of Complete Regression System, by Ragnar Frisch. Oslo: Universitetets Økonomiske Institutt. 1934. 192 pp.

Professor Frisch's important work is dedicated to the proposition that all variables in a regression analysis are created equal. He proposes, as a substitute for the usual multiple correlation methods, a complex procedure which begins with the square matrix containing all possible zero order correlation coefficients among the n variables which it is proposed to study, continues through an impressive if bewildering maze of adjoint determinants (which must be computed for all possible subsets contained in the "big set" of n^2 simple correlation coefficients), and concludes with a very unusual "scatterance" and "bunch" analysis from which he draws forth what he feels to be the appropriate regression. It is quite impossible to outline the technique Frisch employs. It will be difficult to present the aims and purposes of the book. But if there is one essential *raison d'être* of this approach, it is the effort to displace the habitual selection of one variable as the "dependent" variable and the casting of all others into the category of "independent" variables, with an approach which will display no disposition to minimize the sumsquares along any particular axis of the n-space postulated by the geometry of the regression problem.

A discussion of this work properly involves a consideration of at least two other publications. The first of these is a shorter, preliminary paper by Frisch ("Correlation and Scatter in Statistical Variables," *Nordic Statistical Journal*, Vol. 1, (1928), pp. 36–102). The second is the work of L. L. Thurstone, Professor of Psychology at the University of Chicago (*The Vectors of Mind*, Chicago, 1935, University of Chicago Press). Frisch is not a facile writer of English, and, although the service he does English readers by putting his important contributions in their language is a major one, all who seek to understand *Confluence Analysis* must prepare themselves for the translation of familiar concepts from the unusual exposition and notation Frisch employs into more customary idiom and symbol. In this task the 1928 paper will be found of great assistance.

Most remarkable to this reviewer are the astonishingly parallel yet clearly independent developments of the application of matrix algebra to the interrelations of several statistical variables which have taken place in the two Frisch papers and in the writings of Professor Thurstone. Thurstone's shorter papers on the subject (which he calls "factor analysis," a term American statisticians are likely to prefer to "confluence analysis") have been published from time to time, beginning in September, 1931, with "Multiple Factor Analysis," in *Psychological Review*, XXXVIII, No. 5, pp. 406–427. Thus, although it is clear that none of Thurstone's articles antedates Frisch's 1928 paper, several of them precede *Confluence Analysis* by two or three years. Yet Frisch's later work makes no mention of Thurstone, and in the latter's masterful *The Vectors of Mind* (an excellent summary and completion of his "factor analysis") the Frisch studies are not referred to.

Frisch does seek an empirical criterion which will tell us whether a certain

variate ought or ought not to be included in the regression. His answer is a comparison of the deviation sumsquares along each of the coordinate axes of the n-space in which the regression problem is posed. Then he compares the "spread" of the results of the several minimizations with their "average" value. He deliberately avoids assigning a probability to any of these results, such as the ratio of spread to average. He is not convinced such a probability would have significance, and anyway he prefers to rely on intuitive judgment whether a spread is "reasonable."

One is justified in imposing on Frisch the burden of proof that the regression coefficients his method yields possess a reliability not enjoyed by those calculated from the same data by the ordinary multiple correlation techniques. This Frisch seems not to have done. A very real service, however, is performed by any writer who forces statisticians to reexamine the hypotheses implicit in the procedure they employ. This Frisch certainly has done. No one can read *Confluence Analysis* and then select, as the dependent variable with reference to which a multiple correlation analysis is to be performed, the first variable which comes to mind.

FRANCIS MCINTYRE

Stanford University

Essential Traits of Mental Life, by Truman L. Kelley. Cambridge: Harvard University Press (Harvard Studies in Education, Volume 26). 1935. 145 pp. $2.75.

In the first portion of his new volume on factor analysis Professor Kelley offers a new method for obtaining Hotelling components. The matrix for analysis consists of variance and covariance instead of correlation. The object is then to eliminate covariance from the original matrix and arrive at components which are uncorrelated and measured from orthogonal axes, with variance a maximum in the direction of the major axes of ellipsoids of uniform density.

The process consists of selecting the largest covariance, p_{12}, in the matrix and making an orthogonal transformation of the original variables through an angle θ given by

$$\tan 2\theta = \frac{2p_{12}}{v_1 - v_2} \tag{1}$$

where v represents the variance. It may be easily verified that this transformation gives uncorrelated components y_1 and y_2 with maximum variance in the direction of the major axis (y_1), and minimum variance in the direction of the minor axis (y_2). The largest new covariance is then selected and the process repeated over and over until the final covariance is sufficiently close to zero by sampling tests.

The final result is an orthogonal transformation of the original n variables in terms of n components. It is thus possible readily to obtain expressions

for the n components in terms of the original n variables. Mathematically the whole process of analysis is very simple and direct but probably very laborious, because for n variables the number of necessary rotations is of the order $n(n-1)/2$.

A work sheet and a ten-variable illustration are presented, but to date none of the Hotelling methods or modifications have been applied to adequate test material. Such applications are much needed because the illustrations so far appear to yield trivial and unimportant results. Thus, in Professor Kelley's ten-variable problem, nine components are required to interpret the results. These nine components appear to the reviewer little better than the ten tests themselves and yield no parsimony of interpretation. He should like to see how many significant components would emerge from an analysis of fifty variables.

It is necessary by Professor Kelley's method to use original units rather than standard scores, for in the latter case $v_1 = v_2$ in formula (1) and all initial angles of rotation become 45°, which furnishes a trivial solution. The final components must thus be expressed in terms of the original test units and variances, and this necessity appears to the reviewer a distinct limitation of the method. It is true that arbitrary weights may be attached to the variables, as Professor Kelley suggests, but this procedure merely results in an arbitrary allocation of the components according to the size of the weights. Thus, if variable 1 is so weighted as to have the largest numerical variance, it will be the most heavily weighted with the principal component.

If it is desired to modify Professor Kelley's components to reproduce the original correlation instead of the covariance, it is sufficient to standardize the components. When this is done, however, the matrix of transformation is no longer orthogonal, and the consequent simple mathematical properties are lost. It may also be observed that by Hotelling's method of iteration, expressions for tests in terms of components are obtained (as on p. 60) in which the coefficients do not form an orthogonal determinant. The analyses of Hotelling and Kelley are thus fundamentally different with respect to the property of orthogonality of transformation.

In the remaining chapters Professor Kelley discusses various approaches to the analysis of mental traits and criticizes those of Spearman and Thurstone. The comment on Spearman's Two Factor theory (p. 39) is confined largely to an objection to selecting tests according to the tetrad criterion to obtain a single general factor, and the failure to bring other factors into the picture by a wider sampling of human activity. Since these problems have been dealt with by Professors Spearman and Kelley as members of a joint committee, the comment appears irrelevant.

Thurstone's center of gravity technique is also criticized chiefly on the grounds that the specific non-chance variance should be analyzed. It is also shown that Thurstone's components are simple averages of the variables. Both these objections, the reviewer believes, are met in Thurstone's recent volume on *The Vectors of Mind.*

Professor Kelley has furnished an ingenious and mathematically elegant technique for component analysis. The recent methods of Spearman and Thurstone, however, appear to the reviewer to have greater promise from the standpoint of psychological interpretation and parsimony of description.

KARL J. HOLZINGER

University of Chicago

An Outline of Probability and Its Uses, by Maurice C. Holmes. Ann Arbor Michigan: Edwards Brothers. 1936. viii, 119 pp. $1.50.

The preface states that the book is designed primarily for students of science and engineering. The contents could be covered in two semester hours. Calculus is prerequisite. Besides the usual introductory matter, brief discussions are given on the Tchebycheff inequality, probability paper, Bayes' theorem, Lexis theory, the Pearson curves, beta diagram, chi-test, correlation, and regression. Examples, solved and unsolved, are presented. Only one obscure passage is noted; at the bottom of page 96 it would have been easier to say, "If from the data we compute and plot for any given height y of sons the mean height $\bar{x}$ of their fathers, we obtain the line A of figure 22. Again, if we plot for any given height x of fathers the mean height $\bar{y}$ of their sons, we obtain an entirely different line, B."

It was the fact that the heights of sons tends to step back or *regress* toward the general mean that led Galton to the term "line of regression," and it is pleasing to find this bit of history mentioned. Other good points are made; e.g., on pages 34 and 72 occur excellent discussions of a priori probability, and on page 95 an interesting account of the coefficient of correlation as a measure of common causation. The St. Petersburg paradox and Buffon's needle problem are expertly handled.

The book is an excellent job of printing by lithograph from pages typed with care but not without flaws. Misprints are as follows:

Page 6, line 26, and page 7, line 5; read $e_1, e_2, e_3, \ldots$
Page 6, line 27, and page 7, line 9; read $p_1, p_2, p_3, \ldots$
Page 11, Eq. (10); insert $\sum$ in front of the left-hand member.
Page 23, bottom; read $C\ e^{-k(u^2+v^2+w^2)}du\ dv\ dw$.
Page 45, footnote c; $\phi(x)$ in the left-hand member should not be capitalized.
Page 47, bottom; read Wiley 1923; Longmans 1925.
Page 56, line 15; for "are" read "is."
Page 70, bottom; for "toward the origin" read "toward unity."
Page 72, bottom; for "chance" read "change"; in line 28 read Lexis.
Page 82, Eq. (44); for $1/2\sigma^2$ in the exponent read $\sigma^2/2$ or $\frac{1}{2}\sigma^2$.
Page 84, line 20; read $\bar{m}_1 = 0$.
Page 84, bottom; transfer σ from numerator to denominator.
Page 88; in both equations for P insert $+$ before the last terms.

Page 89, line 18; read Nos.
Page 95, top; the exponent should carry signs +, +, −.
Page 108, fourth list, No. 4; read Whittaker and Robinson.
Page 111, line 6; insert = after $n!$

More serious than misprints are unguarded statements such as on page 111; the series for $n!$ is divergent but asymptotic, not "rapidly converging." Moreover, $n!$ departs ever wider and wider from $n^n e^{-n}\sqrt{2\pi n}$ as n increases; it is the *percentage* discrepancy that steadily diminishes. It is a shock to see a list of "Probable Errors of Statistical Constants," as on page 112. The author in the preface commits himself to the objective view of probability; just why nature should be expected to bow to probability equations we are, however, not told; yet on pages 31 and 34 and elsewhere this assumption is apparently taken for granted.

On page 41, $\bar{x}$ is apparently the mean of n observations; if so, then $x-\bar{x}$ is a residual and not an error; moreover, the σ^2 in Eq. (21) should be replaced by $\sigma^2(n-1)/n$ if σ denotes the S. D. of an infinite number of observations. Or if σ denotes the S. D. of the n observations, as it does on pages 70 and 71, then the normal curves of Eqs. (20) and (21) should be replaced by Student's curve, which, by the way, is not mentioned. On page 71 the *mode* of the sampling distribution of S. Ds. is arbitrarily chosen for an estimate of σ', leading to the factor $n/(n-2)$ in place of Gauss' $n/(n-1)$; and there is no mention of any other possibility.

The vertical axis of figure 15 on page 71 should be labeled "relative frequency per unit of σ/σ'," and not merely "relative frequency." Furthermore, the curve for $n=4$ should start from the origin with a horizontal tangent; likewise the curve on page 19. By the unorthodox classification of Pearson's curves on page 81, the normal curve is Type VII, and there is no mention of the Student curve, or the Type II curve with the two parameters reversed in sign, yet in the beta diagram on page 87 the normal curve is clearly and properly the limiting separation of Types II and VII.

Just why probability is measured in *decimal* fractions (page 3) the author does not disclose; does he perchance mean *rational* fraction? A captious critic might be annoyed at the curious use of three dots (· · ·) here and there, as on pages 18, 21, 24, 27, 62, 86, and elsewhere; or at the novel capitalization. Why, for instance, should theoretical on page 89, and fathers on page 96, be with capitals, yet new sentences on page 101 and 102 be without? Redundant parentheses abound; thus, on page 14 we see (32)/(100) where 32/100 is preferable. Unattached participles occur on pages 12, 35, 46, and 57.

The author pays his debt to Fry by thrice mentioning his *Probability and Its Engineering Uses* in the lists at the end. Rietz's Carus monograph is slighted, whereas his *Handbook* receives double mention.

W. EDWARDS DEMING

Bureau of Chemistry and Soils
U. S. Department of Agriculture

Statistics for Students of Psychology and Education, by Herbert Sorenson. New York: McGraw-Hill Book Company. 1936. viii, 373 pp. $3.50.

The author of this book quite evidently has had to contend with the difficulties of students who ask questions which the conventional textbook does not answer. Also, equally evident, he has been influenced by the fact that all too often his students reveal on examination day an abysmal ignorance of some of the things which the instructor thought he had made quite clear. These are shown by the encyclopedic treatment of some of the topics [the mean and the median, for example, consume 50 pages]; by the using in many places of two numerical substitutions in a formula instead of the conventional one; by pointing out incorrect methods as well as correct; by the number and variety of problems presented; and by the ingenious and concrete examples and illustrations frequently used.

In the preface we are told that the book aims to put its emphasis upon interpretation, logical analysis, and application of techniques; and to develop wholesome skepticism, critical attitude, and a keen qualitative sense (p. iv). The promise is better than the realization. The space which might have been devoted to many concrete problems for critical discussion is occupied by much irrelevant material of which "The Theory of the Normal Frequency or the Normal Probability Curve" (pp. 161–162) is an example, where, after developing the excellent pedagogical device, $(H+T)^p$, to replace the $(\frac{1}{2}+\frac{1}{2})^p$ in the conventional penny-tossing experiments, he fails rather signally to show any connection between such and the results of experiments, unless the very cryptic, "if a very large number of coins were tossed, the broken line connecting the tops of the verticals representing the frequency of the obtained combinations would approach a normal curve," be so dubbed.

Although the book has many excellent features summarized in the first paragraph, it lacks proportion and balance. The quality of treatment is spotty. In the first 160 pages we are taken through the averages and measures of variability; then, in the next 184 pages, through a grand sweep of formulae and concepts in which the intellectual difficulties of elementary students relatively are forgotten. Evidently this is done to justify the book as a two-course book which " . . . contains essentially all the elements of statistics actually used by most graduate students." If intended to be used as a two-semester text, the book, in our opinion, does not go far enough into advanced topics.

This is one of the few texts in which, after having made the distinction, the author strives to do something with "continuous" and "discrete" measures. The result, particularly in the case of the median (which thus is made to cover 20 pages of the text), is, in the reviewer's opinion, disastrous. The reviewer has yet failed to locate a case of discrete measurements in which making the assumption of continuity would not lead to better insight, and better comparability of statistics from study to study than by attempting to deal with the scores as discrete. One wonders what, if anything, the

median (either discrete or continuous), or any other measure of central tendency, means for any such series of ten scores as 6, 7, 9, 11, 13, 15, 16, 17, 18, 19; also whether the student is helped or hindered by statements such as: "When the data are discrete and odd in number, then the middle number is the median (p. 71)." That the median is a point seems not to have been appreciated; that it may be treated most economically as a special case of all percentiles has been ignored.

With the exceptions noted, the statistical practices used are excellent. We did note figures printed at the ends of bar charts (p. 30), but there is good precedent for this aberration. A valuable exercise to develop thinking about functional relationships is to be found in some 60 examples of relationships (pp. 186–188) wherein the student is required to judge whether the correlation is positive or negative. The chapter on Sampling, Chance and Probability of Occurrence is decidedly concrete and appropriate to the kinds of students for which it is intended.

Derivations of formulae are conspicuous by their all but total absence.

If supplemented with an abundance of real problems to develop more fully the intended criticalness of judgment—particularly in the second half of the book—it is the reviewer's judgment that the text will be more effective than the average. A two-course book deliberately intended to be interpretative but "not to the neglect of computational skills or the statistical techniques themselves" with difficulty is packed into 373 pages of large type.

HERBERT A. TOOPS

Ohio State University

Graphs—How to Make and Use Them, by Herbert Arkin and Raymond R. Colton. New York: Harper & Brothers. 1936. xvi, 224 pp. $3.00.

Graphic Methods for Presenting Business Statistics, by John R. Riggleman. New York: McGraw-Hill Book Company. 1936. *Second Edition*. xiii, 259 pp. $4.00.

Rich Man, Poor Man—Pictures of a Paradox, by Ryllis Alexander Goslin and Omar Pancoast Goslin. New York: Harper & Brothers. 1935. viii, 85 pp. $1.00.

Professors Arkin and Colton have provided a brief, readable book on graphic methods, doubtless quite adequate as a text for an elementary one-semester course in graphic presentation. It is not complete enough, however, to serve as a reference book, and the publishers do the authors an injustice when they claim " . . . every phase of the technique of making and using graphs is here discussed . . . " and again when they assert "not only are all the different methods of graphic presentation described in detail but illustrations of all applications are reproduced from a number of fields. . . . " Publishers should refrain from claiming an inclusiveness which greatly exceeds the author's intention. There is more emphasis in this book on "how

to make" than on "how to use" and almost nothing is said about how and where to obtain the necessary basic data. There is a valuable chapter on "The Equipment for Graphic Presentation" which, however, seems to the reviewer to be so placed as to be somewhat in the nature of a digression. There is a chapter entitled "Graphs for Computation" and another dealing with "The Reproduction of Graphs." The chapter on "The Ratio Chart" could have been expanded with profit; as it stands it is definitely less complete than the corresponding treatment in various general textbooks on statistical methods. The polar coordinate chart, the 100 per cent triangle, and the arithmetic probability chart are included in the chapter which discusses ratio charts. A separate chapter could well have been devoted to these and other devices.

Dr. Riggleman's book is a revision of his earlier book (1926) of the same title. The topics discussed are the same as before, but the chapter on "Technique of Drawing and Lettering Statistical Charts" has been shifted to the appendix. The charts and illustrations were profuse in the original edition, and there has been but a slight increase in the new edition. Many are new, however, and some time series charts have been brought up to date. The general appearance of the charts has been improved by frequent substitution of block lettering for titles and scales in place of freehand or typewritten lettering previously used and by the use of better chosen hatching and shading for bar charts. Some of the charts in the second edition (for example, numbers 38, 40, 110, 132, 141) appear to show the same data as before revision but with new dates. This, however, is permissible (except in the case of Chart 141), as they are merely shown for purposes of illustration and are not designed to fix a date-connected fact in the mind of the reader. It is a tremendous task to bring up to date a book having more than 250 charts. There are a few which were neglected. Chart 55 (Why it Costs so Much to Mine Anthracite), which is undated, would doubtless be different today, as would also Chart 88 (Hourly Traffic and Operators Required in a Telephone Office) and Chart 174 (Stopping Distances for Motor Vehicles with Efficient Brakes), which are likewise undated. Chart 56 (How the American Family Spends its Dollar) has been altered, but in neither edition did this chart have a date to identify it.

Although the Riggleman book has no chapter on "Graphs for Computation," it is more complete than the Arkin and Colton book in respect to graphic technique and illustrations of charts. Organization and routing charts, which are discussed by Arkin and Colton, are omitted by Riggleman, since they are not based upon statistical subject matter. Arkin and Colton are more meticulous than Riggleman in stating the sources of charts and data.

Rich Man, Poor Man is "part of the educational program of the People's League for Economic Security," and it "presents in a nut-shell the philosophy of the League, a philosophy which the League aims to see realized one day as a practical reality." The pictorial charts were prepared by Delos Blackmar; Willard A. Atkins functioned as economic adviser to the authors. The

dust cover carries the names of the editorial committee (Stuart Chase, Henry Pratt Fairchild, and Harry A. Overstreet) but fails to give the authors their proper mention. This ultra-elementary presentation is an argument for the social ownership of means of production, credit, power, transportation, and distribution and is incidentally an appeal for additional members for the League. Technically this book leaves much to be desired. The combination of soft, porous paper and blue ink is not all that could be wished for. Compare, for example, the chart on page 25 with the same chart reproduced in black and white on page 104 of the Arkin and Colton book. An appendix gives the sources for charts and data, arranged by chart numbers, but, unhappily, the charts are not numbered. For their data the authors sometimes referred to primary sources, but more often not. In either case they do not comment on the reliability of the data used. There is not space here for detailed comment or criticism, but the repeated and unrelieved use of small-figure pictorial charts seemed to this reviewer to become monotonous, and the chart on page 6 brings forth once again the unwarranted association of horses and horse power.

FREDERICK E. CROXTON

Columbia University

On Quantitative Thinking in Economics, by Gustav Cassel. Oxford: The Clarendon Press. 1935. vii, 188 pp. $2.25.

Professor Cassel believes that economists must "relieve themselves of the oppressive burden of withered notions and barren dogmas" and in this volume endeavors "to indicate the principal lines of the work required and to illustrate its nature by discussing some few important points relating to the basic concepts and methods of economic science." To this end he develops chapters on production, value and money, income and its use, gradual approximation, quantitative relations between product and factors of production, and the equilibrium theory of prices, which draw heavily upon his *Theory of Social Economy* and consider various criticisms of his published work of this nature.

With justifiable indignation Professor Cassel condemns writers possessing superficial knowledge of mathematics who represent vague concepts, often of little or no economic significance, by mathematical symbols and attempt to draw authoritative conclusions from mere mathematical processes. He rightly insists that "in choosing our definitions we must always let the economic point of view be decisive," and that "as far as quantitative concepts are concerned, their quantitative character should be made quite clear, their measurability be unambiguously established, at least as a theoretical possibility, and a definite unit of measure be fixed." Professor Cassel next declares that "no definite meaning can be attached to the idea of a period of production," except in a money economy where both efforts and wants are represented by prices and an average of periods would be conceivable. But he then seems to become confused over the nature of an average, stating

that such is a sum of quantities divided by their number and entirely ignoring in later discussions possibilities of harmonic, geometric, and other useful averages. Other examples of unskilled mathematics appear on pages 17 and 134.

In a discussion of value and money, the author declares that "the idea of an absolute value of a thing in itself has to be abandoned in economic science—definitely and forever." Values must be replaced by prices, and "economic theory must start with the construction of a general theory of prices." Such a theory can, of course, be quantitative, and, as he states, to superimpose upon it such pseudo-scientific notions as utility or value as a thing in itself is a disservice to economics. The author then advances four arguments in favor of a monetary system based upon a fixed-price-level standard. In the course of discussion he maintains that nations should first adopt suitable standards—usually based on wholesale prices although the particular base is apparently of no great importance—and compel the economic systems, both internally and in relation to other countries, to adjust to these standards. Criticizing severely a publication of the League of Nations based on the assumption that technical advance should be reflected in a falling price level, Professor Cassel maintains that higher wages and increased standards of living would be the outcome under a fixed-price-level standard.

The author next attacks the "popular fallacy" that "saving renders a part of the social income inoperative as purchasing power," thus differing widely with Keynes and others. Here, however, Professor Cassel distinguishes between purchasing power as he defines it and the supply of means of payment as others define it, the difference appearing to the reviewer as a hair-splitting quibble. In this chapter the author appears to go to unnecessary extremes in his frequent severe criticism of the work of other theoretical economists.

Despite its name, the book is characterized by a notable lack of use of the best modern statistical techniques. For instance, in discussions of deviations from theory in Chapter II, no recognition is given to the problem of statistical significance, whereas this is the fundamental problem of approximations. Again the argument on page 98 regarding the character of wave-like motions of business data lacks force because of this underlying failure to consider at all questions involving significance. Consequently, the reviewer cannot reach Professor Cassel's conclusion that there is no general problem of the business cycle and that "the very question why the actual development should follow a curve composed of successive ups and downs is not a problem that requires an answer, such a movement being simply self-evident necessity." In support of the reviewer's position it may be noted that he has collaborated in deriving a quantitative demand curve for residential building and demonstrated that the mere striving for profits in this industry leads to a self-perpetuating cycle, because of the functional nature of the demand.

The reviewer must also disagree heartily with the statement that one must always go back to the pre-War days for data to prove or disprove theses relating to business cycles, because post-War monetary disturbances have been great. A useful picture of business cycles must represent both periods,

such as does, for instance, the study of building above mentioned. Also the reviewer believes that the author is entirely too pessimistic regarding the possibilities of economic forecasting. Thus, even with such political interference as occurred under the National Recovery Administration, the majority of forecasts made by its economic staff of outcomes of various NRA experiments were essentially accurate.

In the reviewer's opinion by far the best chapter is that dealing with prodduct and the factors of production, wherein is given an able criticism of the marginal productivity theory and attempts of Douglas and others to test it in simplified form. Here the notion of continual growth, both of labor and capital, such as is found in the writings of Carl Snyder and others, are developed at length. It is only in this chapter that the book even approaches the quantitative stage; figures taken from Mills, *Economic Tendencies in the United States* and from other workers are cited at length. But not all the interpretations are correct; for instance, the author speaks of great progress in the building industry in the years 1923–1929 as a trend, whereas there is no sharply upward long-time trend in building activity, and examinations of long series for this industry reveal nothing unusual about the 1923–1929 cyclical upswing in the long building cycle of 15–20 years, which, according to Professor Cassel's definitions, would be random.

On the whole, however, this little book is challenging and well-written and deserves the careful study of all students of economics.

CHARLES F. ROOS

Cowles Commission for Research in Economics
Colorado Springs, Colorado

Income and Economic Progress, by Harold G. Moulton. Washington, D. C.: The Brookings Institution, Publication No. 68. 1935. xi, 188 pp. $2.00.

This book is the last (fourth) volume in a series of studies published by The Brookings Institution. These studies, widely discussed throughout the world, aim at determining the decisive deficiency that prevents the economic machinery from working at full speed and, moreover, from attaining the perfection that could have increased its efficiency far above its present level. Mr. Moulton presents many striking data that are known to the readers of the former volumes.

The point he makes in this book is the following: Mr. Moulton discards the opinion that at any time in this country consumption surpassed the proper limit, hampering the accumulation and investment of capital and hence the increase of production. On the contrary, consumption could have been always considerably above its level without any danger for the development of the productive forces. The main problem, therefore, is not how to retard the upward movement but how to keep production on the level that it attains during the boom—or, which amounts to the same, how to increase consumption. This being his main view, Mr. Moulton can be classed as an

under-consumption-theorist; not, of course, in the primitive sense in which this theory has been usually interpreted by orthodox economists. He discusses the means usually suggested, namely: equalization of incomes; taxation; and raising money wages. These measures would not help, he believes.

So by excluding these possibilities he proposes that price reductions are the appropriate measure for eliminating the hindrances that are in the way of a quicker and uninterrupted economic growth. He insists that this proposal is in line with the opinion of classical economists: price reductions would spread the advantages of technical progress over the whole economic field; not only workers but every consumer then shares the fruits of increasing efficiency; even profits would not decline, as the increasing output reduces the overhead costs and might, at lower prices, yield higher profits. (This last statement, however, would hold true only for commodities which satisfy an elastic demand.) Thus Mr. Moulton expects that this perfect harmony, of which the laissez-faire economists dreamed, may be established and the progress of our economic system might be secured without any serious setbacks.

The general principle expressed in this trend of thought is widely shared. It is almost common opinion that rigidities are in the way of full utilization of our potential productive power. But there are differences as to the center of these rigidities: one group of economists is stressing the rigidity of wages, which, being the main costs, are responsible for the restrictions in production; the other group is stressing the rigidities of prices, interest rates included. This difference runs parallel to the difference in opinion concerning the abundance or scarcity of capital. But both views aim at the restoration of free competition.

If rigidities are the main trouble, and if these rigidities did not exist in the first period of our industrial age, the question has to be answered: what are the roots of these rigidities? They center mainly in the technical changes of production that did away with the basic feature of a competitive market: namely, that the single producer can contribute only an infinitesimal share to the total production. It was this feature that guaranteed competition, increasing production, and thus price reductions parallel with reduced costs. Mr. Moulton elaborates this point on the lines of the generally accepted view. But he insists that prices should be reduced according to reduced costs. Even if we accept this view, how can it be done? How can free competition be restored? That is the crucial point. Mr. Moulton does not pretend to solve the problem in his book; on the contrary, he says that it would be a complicated task (p. 164): "It would need to be highly detailed to meet the peculiar situations of varying industries, and the time is not yet ripe for the presentation of anything more than general principles." But one must ask the urgent question: How can the aim be achieved unless a central economic authority can enforce increasing production, if a smaller production at higher prices is decided upon by the owners of the industrial enterprises? Furthermore, what shall be the measures this central authority shall take? Publicly owned production ("yardsticks") or commands? How can private business

be made to obey these orders unless the economic authorities guarantee a minimum of profits? And so on.

Probably questions of this kind explain why only the general principle was stated by Mr. Moulton, who, by the way, shuns the establishment of any dictatorial economic authority.

Now we cannot close our eyes to the fact that the very basis of our potential economic efficiency, namely, large scale production, is, in the opinion of Mr. Moulton, the reason why free competition does not work. We are confronted, in other words, with an antinomy of the system, as the same forces that accelerate production retard the speed of the machinery: Now it seems that there is no way to eliminate the rigidities except by breaking up the great units of large-scale production. And that would mean, in many cases, the return to an older and less efficient technique. We could get rid of the rigidities but of the high efficiency of modern production at the same time. Thus, we have to take the rigidities as a fact, and we have to use them, if possible. Those who would eliminate the retardations must accept the economic machine in its present working and must try to accelerate its speed by other devices. They can be—if the present system is to be preserved—only measures of monetary policy, as they were taken during recent years, namely, devaluation and public spending. These measures would not be necessary perhaps if rigidities (i.e., lags) did not exist. But as we cannot get rid of the lags, we have to use them—which is, in my opinion, the kernel of the economic policy advocated by J. M. Keynes and those economists who more or less side with him.

These devices are certainly no panacea, though they proved to be workable to a certain extent. The basic problem, however, is not solved by them. This point cannot be discussed here, but it may be said that it is questionable whether even a perfect flexibility could assure the full working of our economic machinery if labor-saving devices and technical progress surpass a certain limit. A careful analysis of the consequences of technical progress should, I think, give some hints for a better judgment about the processes through which our present economic system tends to under-utilize its capacity, and, hence, about the measures that can be taken in order to secure its full working.

EMIL LEDERER

Graduate Faculty of Political and Social
Science in the New School for Social Research
New York City

The Future of Gold, by Paul Einzig. New York: The Macmillan Company. 1935. x, 135 pp. $2.00.

This interesting little book by an Englishman sets out to answer the following four questions:

1. What will be the course of the London price of gold in the near future and in the more distant future?

2. At what level will sterling and other principal currencies be stabilized?

3. What kind of monetary systems will the leading countries adopt when returning to stability?

4. What will be the tendency of gold and commodity prices after stabilization?

His analysis no doubt is of more interest to England than to the United States. The price of gold continues to change in England, and shares of gold mining companies occupy a more important place in the investments of Englishmen than of Americans.

The author's conclusion that the London price of gold would certainly rise within two years was based on the following assumptions:

1. That the balance of payments would tend to depreciate sterling.

2. That the United States would certainly depreciate the dollar to 50 cents gold and perhaps even further, and that England would follow at least in part. Even though France devalued or allowed the franc to depreciate there would be little effect on the sterling price of gold unless the United States devalued or depreciated with France. In such an event, the pound would be allowed to depreciate with the dollar.

3. That decided improvement in economic conditions must occur before hoarders would liquidate their gold stocks.

The author pointed out several tendencies in support of the contention that the balance of payments would tend toward a decline in sterling. He argued that foreign lending would increase, that English securities held abroad would be returned, that several of the dominions would use sterling balances already acquired to pay debts to England, that the Exchange Equalization Account never sold as much gold in support of sterling as it had previously purchased, and that political factors favored sterling depreciation. These factors no doubt support his conclusion, but as yet their effect has not been sufficient to cause a decline in sterling.

The reviewer feels that the probability that the United States will further depreciate the dollar in this readjustment period is small. It is the reviewer's opinion that an advance in the price of gold in France which is less, the same, or somewhat more than the advance that has already occurred in England will have little or no effect on the London price. If these statements are true the author's second reason for a higher gold price in London has little weight. With the influence of the United States and France eliminated, the chances for a rise in the price of gold in London do not appear so great as the author contends.

The third reason that gold hoarding would continue until there are decided improvements in economic conditions, is probably true.

The author comes to the conclusion that a large share of the world will return to a gold standard. He believes, however, that stabilization will not come for a number of years and only after heavy devaluation by a large number of countries.

The author reaches the conclusion that currencies will be devalued and stabilized at such a rate that currency prices in all participating countries

will rise, because ". . . It is impossible for all currencies to be undervalued in relation to each other. It is, however, quite possible for all currencies to be undervalued in terms of gold. . . ." The author means by "undervalued in terms of gold" that prices in each country will rise after devaluation and stabilization in proportion to the amount of undervaluation in terms of gold. Hence he reasons that stabilization will not mean falling prices and deflation to any country but will result in rising prices in all countries. The amount of rise in each country would depend on the undervaluation of its currency in terms of gold.

There is a question whether or not most currencies are not now undervalued in terms of gold. Will not commodity prices in the sterling block, in the United States, and even in the remaining gold countries rise without further devaluation? The present purchasing power, or value of gold, is still approximately at the peak of the crisis and too high for its relative supplies, and most countries can anticipate higher price levels without further devaluation. With the heavy devaluations anticipated by the author, the increase in price levels will be even greater.

It seems to the reviewer that the author has overestimated the chances of further advance in the London price of gold and by implication has exaggerated the investment possibilities of gold and gold mining shares. If the purchasing power of gold declines, gold and gold mining shares will not be as profitable as formerly, and in fact other types of investments will probably be more profitable.

G. W. HEDLUND

Cornell University

The Theory of Monetary Policy with Special Reference to the Relation between Interest Rates and Prices, by Bhalchandra P. Adarkar. London: P. S. King & Son, Ltd. 1935. xi, 125 pp. 7 s. 6 d.

Mr. Adarkar's book is well worth reading. Its value lies not in any major solution brought forward but in the penetrating and thoughtful comments on current ideas. He has a wide knowledge of the literature of interest-rate theory and a very real ability in combining the doctrines in this field with those in monetary theory as more narrowly defined. In making a broad survey of the dominating concepts he lays the groundwork for further progress.

The book is in no sense confined to a reiteration of old truths but throws new light on obscure problems. If one attempts to summarize the contribution in this study, one gives a somewhat false impression, because the cautions and suggestions sound familiar, but careful reading makes it evident that there is a somewhat new combination of ideas on policy and that even such well-known warnings as those urging central bankers to apply the brakes before speculative movements get out of hand are phrased in a manner which gives them a new force and which makes their application to specific situations somewhat more definite.

The faults in the book are immediately clear even to those who welcome its serious tone and its honest attempt to get at the fundamentals. The book covers a very wide area and a considerable span of time. It does this with surprising success in the short compass of 125 pages. In view of the limits imposed by the essay-like structure, it is not surprising that one reads the treatment of certain theoretical points with a strong desire for more complete elaboration and more emphasis on major issues.

When, for instance, Mr. Adarkar discusses the Riefler-Keynes theory of the relation between long and short money rates, he is getting to the heart of his problem. A brief five-page treatment of the matter leaves the reader somewhat up in the air. The general outlines of the theory and the nature of Professor Simmon's criticism are clear. When, however, Mr. Adarkar amplifies his own ideas and asserts that central bankers can control long rates but not mainly because of a necessary relation between short and long rates, one wishes for a further elaboration of his reasons. His summary statement that many instruments are available to the monetary authorities, including open-market operations and similar instruments, leaves one with a sense of incompleteness. The general nature of his treatment implies that he has thought the matter out somewhat concretely, but the two or three paragraphs devoted to his constructive advice at this point are insufficient to bear the weight of his conclusions.

These criticisms are intended to indicate points at which some readers will object to the manner of treatment. There are other points at which some will disagree with the particular theories brought forward. Neither history nor a summary of gold-standard doctrines bears out the comments made on the role of international gold movements. Too large a responsibility has been thrown on this mechanism of adjustment in Mr. Adarkar's discussion. It is rarely claimed that the movements of the precious metals can adjust cost and selling prices to each other either within or between countries. Even the classical economists assume a complex interplay of competitive forces in many markets. Moreover, even this many-sided adjustment only brings a temporary and occasional balance of prices.

A sounder criticism of the gold standard grows out of the claim that it has greatly accentuated and prolonged depression conditions, but this assertion is only valid when expressed in terms of the uneconomic strains exerted on the monetary system by post-war debts. It will be difficult to reconstruct the sadly impaired money systems of the western world if it is not recognized that a reasonable management of international credit conditions, some cooperative efforts to share gold accumulations and investment resources in a rational manner, can moderate price fluctuations. If a completely fatalistic or mechanistic attitude towards the collapse of predepression prices prevails, no progress can be made.

A number of comments and criticisms would be worth quoting, but it is better to refer the reader to the text, as the value of the discussion lies so much in the considered judgment of the phrasing and the attempt to combine somewhat divergent views in a coherent interpretation of real con-

ditions. The remarks on the confused use of "barter" and "Crusoe" economics are worth quoting. The general position taken is nearer Mr. Keynes than that of Mr. Hayek, but the eclecticism manages to salvage a variety of suggestions taken from different bodies of doctrine. If the book runs to later editions, more careful editing of verb forms would greatly increase the effectiveness of the text.

ELEANOR LANSING DULLES

Bureau of Research and Statistics
Social Security Board

Money and Banking, by George William Dowrie. New York: John Wiley & Sons, Inc., also London: Chapman and Hall, Ltd. 1936. viii, 512 pp. $3.25.

Professor Dowrie has written a textbook that will, in the reviewer's opinion, become very popular in one-semester courses which endeavor to give the student a broad perspective in this field. It is not cluttered up with an encyclopedic array of facts which so often tax the student's patience as much as his memory. Written in a simple, clear, easy-flowing style, it should arouse and hold the interest of the reader. It is concise, but as a rule not overly so. What the author has to say he says directly; there is hardly a surplus word in the volume. Frequent topical and paragraph headings as well as numerous summaries show careful planning and organization.

The subjects treated are the usual ones in such a text, but the author has wisely given more space than has been customary to central banking in this country and abroad. Five chapters are allotted to this subject. Two additional chapters deal with foreign banking systems, containing much recent information of value. The reviewer believes that some expansion in the discussion of the credit policies of the Federal reserve system would have been advisable. It is doubtful whether the student will gain a sufficiently clear understanding of the technique of credit control and the chain of causation set into operation by such control.

The reviewer would have preferred a more thorough discussion of the relationship between money and bank credit and prices and a more complete history of price movements. The emphasis on the events of the last fifteen years will, in the opinion of some, leave the book somewhat lacking in the presentation of a historical background. Although Professor Dowrie favors a gold standard he is by no means a fanatic in this respect. He will be criticized by some non-orthodox monetary theorists for not giving sufficient space to the strong attacks which have been made in recent years against that standard. In his criticism of much of the monetary policy of the New Deal he is scholarly and restrained, an example which some of his colleagues in this field might well follow. Whereas many monetary economists are demanding a return to the gold standard, Professor Dowrie states correctly that we have been on a restricted form of that standard since early 1934.

The text will lend itself admirably to classroom discussion, for Professor Dowrie has opinions, and he leaves the reader in no doubt concerning them.

A summary of some of his most important conclusions follows. A relatively stable price level is preferable to a fluctuating one. The modern statement of the quantity theory of the value of money (as it is expressed in the equation of exchange) has much validity when properly interpreted, although it cannot be statistically verified. A gold shortage played little part in bringing on the depression. The gold standard of the future must be supplemented by conscious management and by central banks and by agreements leading to the use of gold and its more equitable distribution. The United States should resume redemption in gold bars as soon as practicable. International bimetallism is sound in theory. The gold purchase program was comparatively ineffective, and no further devaluation should be permitted. President Roosevelt is given due credit for having withstood great pressure for more radical monetary legislation. The silver buying program was most unwise. Our monetary system should be simplified still further, since we need only Federal reserve notes and minor coins.

We turn now to the author's conclusions on banking. If the banking system had functioned properly it should have been able through control of credit to have prevented the serious decline in prices beginning in 1929. On the whole, the Federal reserve system has been of value, but it has not been able in the past to exercise proper control over bank credit. Moral suasion, the rediscount rate, and open-market policies have been comparatively ineffective. The bond-buying campaign of 1932–33 was of little help in inducing recovery. The new power of the Board of Governors to vary reserve requirements of member banks, however, is the most powerful weapon it now has for checking an undue expansion of bank credit. It will take great courage to use this and other added powers to prevent the inflation for which the stage is set. It was a mistake to broaden the type of bank asset eligible for rediscount, since the illiquidity of the system has thereby been increased. State chartered banks should be eliminated and all banks brought under national charter. Demand and time deposits in commercial banks should be segregated.

Professor Dowrie's most striking suggestion is one for the reorganization of the Federal reserve system. He would abolish present requirements for membership and transfer the ownership of the reserve banks to private hands. He would then permit any sound bank to have access to the system, as is the custom in many other countries.

He wishes that recovery had been permitted to come from natural causes without so much legislation. But he realizes that in a depression as severe as this one, especially in agricultural regions, it was unavoidable for the Government to endeavor to assist. Although most of the monetary measures taken have been of little aid it was necessary to pass them for political reasons. The Federal Deposit Insurance Corporation has a better chance of success than the former state plans, but it will not be tested until we have another severe depression. It does make the continuance of postal savings unnecessary. The Government should retire from much of its recent activity as soon as possible.

Finally, he urges more international cooperation in monetary matters and

the appointment of a strong national commission to suggest methods of improving our monetary and banking system. The greatest compliment the reviewer can pay Professor Dowrie is to suggest that he would be a valuable member of such a commission.

It has been a long time since the reviewer has read a book on money and banking in which he has found so much with which to agree. He wishes the author had said something about social credit and the 100 per cent money plan. In one or two respects, however, the reviewer must differ. He feels that the Government's monetary policy has on the whole been helpful and that the rediscount and open-market policies of the reserve system are stronger weapons, if timed properly and used with sufficient vigor, than Professor Dowrie believes them to be. Finally, there is considerable doubt concerning the practicability of transferring the Federal reserve banks to private ownership.

CHARLES S. TIPPETTS

The University of Pittsburgh

Les Prix Agricoles Mondiaux et la Crise, by Bertrand Nogaro. Paris: Librairie Générale de Droit & de Jurisprudence R. Pichon et R. Durand-Auzias. 1936. 167 pp. 20 fr.

This book maintains the increasingly popular contention that the divergence between the prices of agricultural and industrial products during the years before 1929 was a major cause of the subsequent depression. In discussing the series of factors to which that divergence is attributable, the author gives a somewhat naïve twist to the story. Emphasis was placed by Timoshenko, in his thorough analysis of the data,[1] on the unbalanced production conditions of the War period and the consequent overproduction and accumulation of stocks. Sir Frederick Leith Ross, in his memorandum to the League Economic Committee,[2] placed somewhat more emphasis on agricultural revival and protectionism in the European importing countries. Ezekiel and Bean[3] emphasized industrial price rigidities which decreased the real purchasing power of farm producers. Emphasis has elsewhere been placed on ineffectual efforts to hold stocks off the market and on the subsidizing of exports in large producing countries. Nogaro mentions most of these factors but places his emphasis on all of them operating together to prevent total world agricultural production from responding to world market price movements as classical value theory ("without wishing to ignore theories since Stuart Mill") provides that it should. He laments the relative *lack* of rigidity in agricultural prices as "one of the immediate and important causes" of the depression. He says that his analysis of the conditions under which wholesale agricultural prices are formed should contribute to the study of the movement of the general price level and thus to the theory

[1] *World Agriculture and the Depression*, Ann Arbor, 1933.
[2] *Considerations on the Present Evolution of Agricultural Protectionism*, League of Nations, Geneva, 1935.
[3] *Economic Bases for the Agricultural Adjustment Act*, United States Department of Agriculture, 1933.

of money and business cycles. His book, however, seems rather an attempt at synthesis than at analysis.

Starting with an attack on the purely monetary theory of business cycles formerly urged by Cassel and adhered to by the League Gold Committee, the book argues at great length that the greater fall of the agricultural than of the industrial price level was more disturbing than was the general decline of all prices. Cassel is criticized for implying that supply is a constant. Nogaro holds that, as far as agricultural commodities are concerned, it is substantially accurate to consider world demand constant. The book then presents some of the available statistics of prices, production, and stocks for the following commodities: wheat, sugar, beef, coffee, cotton, rubber, wood, and a few secondary cereals and textile fibers. The outstanding characteristics of the market for each of these are briefly mentioned, and the similarity of price movement on these many markets is explained in terms of supply and demand. The fact that this is possible without referring to monetary factors is considered proof of Cassel's fundamental error. Since this negative point is stressed throughout the book, it is strange that Nogaro has based his other main argument on a *divergence* between the prices of agricultural and industrial products.

A chapter is then devoted to the French agricultural market as an example of the direct danger to an importing country from protectionism. Internal production tends to increase. When it is adequate for domestic needs an agricultural depression develops within the formerly importing country which may be more severe than the world depression against which the original protective barriers were raised. It is especially interesting to the reviewer, however, that Nogaro seems to believe that until agricultural prices fall below industrial prices, on the basis of some previous "normal" year, a severe depression cannot occur. Had he picked a country less nearly self-sufficient in agricultural products, he might have found otherwise.

The book does not offer a remedy for the lack of stability which it points out in world agricultural prices. Nogaro thinks that relatively free trade in agricultural products might, by again permitting the focusing of supply and demand at a central market, be a remedy; but he sees no tendency in that direction. He does expect such a tendency to appear, however, unless a new bond (probably an authoritarian one) between price and production is developed out of the numerous attempts at market organization which are now going on.

ROBERT B. SCHWENGER

Bureau of Agricultural Economics

American Agricultural Conditions and Remedies, Preliminary General Review by the Research Staff of the National Industrial Conference Board, Inc., New York. 1936. vi, 57 pp. $2.00.

The study of American agricultural conditions and remedies is divided into four parts. The first part, entitled "The American Agricultural Picture

Today," attempts to give the essential features of American agriculture in fifteen pages. It is entirely too general. The conclusion in this section is that American agriculture is in an unhealthy condition owing largely to over-commercialized farming, to the falling off of foreign demand, and to an excessive amount of farm tenancy. The second part, "The Measurement of Agricultural Conditions," does not go extensively into real measurements but rather presents a comprehensive view of farm income, which is very timely. The chief point is that too much emphasis has been placed on per-unit prices of farm products and not enough on income, including both total cash income, value of home-grown commodities, and other sources of tangible and intangible satisfactions. Part three is a brief analysis of "Past Attempts to Help Agriculture." This section deals mostly with the programs of the Farm Board and the New Deal policies. The general conclusion is that, although these programs may have done some good as emergency measures, they have not solved the agricultural problems. They say, "In the case of wheat and cotton, only a concerted world reduction might help, but this is entirely impracticable. For animal products and corn, reduction of production is a false hope for the farmers." The Soil Conservation program as now administered is interpreted as having the same objectives as the A.A.A. on the ground that "the approach is changed, but the objective is the same—the hope of greater farm income from decreased production" This criticism is certainly justified under present administration. Is it not possible, however, that the law itself is not so much at fault and that, guided by different objectives, it might be made the base of a constructive program? Part four presents a "Positive Program for Agricultural Improvement." It is the most stimulating and thought provoking of all. Briefly stated, the program may be summarized in terms of a return to the family-owned and family-operated farm for security of income and expansion of markets; the latter to be the result of the farmer's consuming more products grown on his own farm. In addition to this major remedy, it is proposed to expand markets by having a stronger foreign trade policy and by increasing domestic consumption, to develop a systematic program to discover new uses for farm products, to decrease farm tenancy, to remove submarginal land from wheat production, and to provide outside employment for much of our rural population.

There are a few errors of fact and interpretation such as the reference to Florida sugar plantations, but they need not concern us here.

Summarizing briefly, I think it may be truly said that the main purposes of the booklet are to present a philosophy of agriculture and a program to convert that philosophy into a reality. To the authors, farming is not merely an essential business, it is a way of living that must be preserved as a national policy. They say "The opportunity to establish a large farm population is of national significance from a social as well as an economic point of view and calls for careful consideration and wise leadership." In another place they say "agriculture has an infinitely larger job in the life of the nation than the mere production of its food and raw materials." In view of

the implications of this philosophy, it is no wonder that specialized, commercial, motorized agriculture is looked upon with distrust. It tends to increase the size of farms and reduce the number of farmers. From their point of view, it adds to insecurity of income and tenure. In this connection, they say "the deeper instincts of the farmer himself seem to be pointing in the direction away from the uncertainties of the over-commercialized farm and toward the greater security of the well managed family farm."

This idealistic point of view toward agriculture is not new, especially among those looking at the industry more or less from the outside. To them the hope is in the family farm, well tilled; but the problem is not as simple as that. Indeed, it is difficult to generalize about agriculture in the United States. Probably the most distinctive characteristics of American agriculture are its high degree of regional specialization and its dependence on industry and on interregional and world trade for markets. These characteristics, coupled with the rapid mechanization and motorization of farming in large sections of the United States, are major factors moulding agriculture in this country. We should like to have seen these powerful forces analyzed in terms of an agricultural program. My guess is that in the broad deltas, prairies, and plains, the real heart of American agriculture, the sons and daughters accustomed to power machinery as they are will tend toward still larger-scale commercial farming.

Even now, as we are just coming out of the depression, in the areas adapted to the use of large scale motorized equipment, specialization is going forward at a great pace. Builders of power driven machinery are preparing for the greatest business in history. In view of these facts, is it not probable, in some regions at least, the trend away from specialized crop production is an evidence of weakness and not of strength?

Security of income is pointed out as one of the major objectives in agriculture. This objective is generally recognized. In the regions adapted to large-scale machine agriculture, however, they are seeking security in crop insurance rather than crop diversification, as the authors suggest.

Many others as well as the authors of this book seem to think that the farmers are somehow better citizens, especially the land owning farmers; that they are individualistic and independent. Will the facts bear this out? Have not some of the most radical movements, the most socialistic experiments in our history originated in the farming states? Even now, are not the farmers the most ardent supporters of the more or less socialistic experiments of the New Deal? Do not these expressions of discontent arise out of low incomes, rather than inhere in any type of occupation, and is not the surest way to have a contented, patriotic farm population to have farmers with larger incomes, which will probably mean greater emphasis on cash producing enterprises and a declining number of farms, other than "play" farms?

A. B. Cox

University of Texas

Public Utility Regulation and the So-Called Sliding Scale, by Irvin Bussing. Columbia Studies in History, Economics, and Public Law, No. 415. New York: Columbia University Press. 1936. 174 pp. $2.75.

Economics of Electric Distribution, Effects of Reduced Rates in T.V.A. Service Areas, by Edward Falck. Chattanooga: Tennessee Valley Authority. May, 1936. 44 pp.

Public utility economics in this country has been so concerned with that segment of medieval scholasticism, the problem of valuation, that more important issues have been neglected. Recently, however, attention has been directed to the question of operating efficiency of public utility enterprises and of methods of securing the advantages of efficiency to consumers. It is too obvious to require restatement that existing techniques of regulation have little to contribute either to the stimulation of efficient methods of operation or to the determination of rates which shall no more than cover the costs of efficient operation. The sliding scale and Government "yardsticks" represent two different ways of dealing with problems which present regulatory methods neglect.

Mr. Bussing defines the sliding scale to include "any form of regulation in which the profit allowed increases or decreases in proportion as prices decrease or increase." Strictly speaking the sliding scale contemplates a standard return on the investment in a public utility enterprise with provision for increase if the enterprise lowers the price of its services and decrease if prices are raised. This method of rate regulation was first introduced in England where it was applied to gas companies and later to electricity enterprises. In this country it was used to regulate gas rates in Boston but was there abandoned, through no fault of the system itself, in 1926. At the present time the most important application of the sliding scale in the United States is in the regulation of the Potomac Electric Power Company in Washington.

It is clear that at best the sliding scale is a rather crude method of stimulating efficiency. It makes no distinction between the influences on costs and income within the control of management and those which lie outside. A reduction in the cost of supplying electricity caused by a fall in the price of labor and materials or by an increase in the population of the area supplied and consequently in the number of consumers will lead to higher returns under the sliding scale as effectively as will a reduction of costs brought about by more efficient management. Moreover the rewards of efficiency go directly to the stockholders and may or may not be shared with management.

Nor does the sliding scale avoid the difficulties of valuation which have plagued utility regulation in this country. The determination in Washington of the investment on which the Electric Company was to be entitled to earn a standard return resolved itself into a compromise between the actual investment figures of, roughly, $24 millions, favored by the Commission, and the reproduction cost figures of $44 millions favored by the company.

In periods of considerable price changes, furthermore, any sliding scale system breaks down as the War-time experience in England and in Boston shows.

Nevertheless the author concludes after a summary of the available evidence that the sliding scale represents an advance over present methods of regulation. This conclusion, however, is hardly capable of successful demonstration. The evidence consists largely of cases in which prices of utility services were lower under the sliding scale than under other methods of regulation or in which prices, as in Washington, fell rapidly after the introduction of the sliding scale. The Washington case is an interesting one. The author is well aware of the existence of other influences than the method of regulation on electrical rates, but no technique is presented, nor perhaps could one be devised, of isolating the influence of the sliding scale from other influences.

The book, though better on the American than on the English material, is a useful summary of experiences under a method of regulation which is likely to become of considerable importance in this country.

The T.V.A. pamphlet is concerned primarily with the elasticity of the domestic demand for electric power. Statistics are presented covering two years' experience in the twelve communities which by January 1, 1936, had begun to buy power from the Authority. Increase in consumption at the lower rates has been extraordinary, but again students are faced with the difficult problem of isolating the effect on consumption of rate reductions from other influences.

EDWARD S. MASON

Harvard University

Britain in Depression, A Record of British Industries Since 1929, by a Research Committee of the Economic Science and Statistics Section of the British Association. London: Sir Isaac Pitman & Sons, Ltd. 1935. viii, 473 pp. $3.00.

This book is the work of 22 collaborators under the chairmanship of Professor J. Harry Jones of the University of Leeds. Part I, General, contains three chapters: Introduction, or rather a summary, Currency and Banking, and Industrial Relations. Part II, Separate Industries, contains 21 chapters dealing with various industries, and one with national and local finance. The subtitle of the book indicates the principal aim of the endeavor, which was to provide a record of the depression while the events are still fresh in mind, but in almost all cases the discussion and data are extended backward to the early post-War years or to 1913.

That it is well to have such a record of British industry needs no emphasis here. Significant economic trends are apparent. The sickness that prevailed in Britain in many lines of industry during the 1920's is clearly revealed, and the world-wide collapse following 1929 is shown merely to have augmented the difficulties. The attempts to meet the problems in the many

lines of enterprise are well portrayed. These emphasize a major trend which has appeared in every capitalist country, namely, an increased degree of control both through cooperation among the various groups within an industry and through the agency of government. In agriculture, textiles, coal, and shipbuilding, for examples, many schemes have been tried designed to reduce capacity and control output. The underlying philosophy of these relatively new methods of control is not discussed in these pages. The authors content themselves with setting forth the record of what has been attempted or done. It may be observed, however, that from one angle the controls being set up may be regarded as concerted attempts to maintain scarcity and from another as a means of adjusting output to market through cooperation rather than by the old method of eliminating uneconomical plants through foreclosure and abandonment. Whatever may be the justification or lack of justification of these present-day methods, they clearly indicate that we have gone a long way from the stark individualism which prevailed when modern capitalism was in its infancy.

Another over-all picture which arises from a perusal of these pages is that of the delicacy of present day economic arrangements. The marked degree of interdependence, which to Britain is emphatically world-wide, makes the economic system as a whole highly susceptible to the disturbing influences of new methods, new products, or new sources of supply, and to changes in tariffs, monetary policies, wage or interest rates, taxation, etc. The juggler's feat of maintaining an economical balance among cost and selling price and market demand, which the business manager has always had to perform, is becoming increasingly difficult as the elements that affect them become more and more numerous. The British industrialists, who have a long record of resourcefulness, are being hard put to it since the close of the War, as this volume aptly shows. The measure of their success from now on will, we may hope, be embodied in other books such as this, fortified as it is, with a running account of events and copious data.

H. GORDON HAYES

Ohio State University

Operating Results of Department and Specialty Stores in 1934, by Carl N. Schmalz. Harvard University Bureau of Business Research Bulletin No. 96. 1935. 42 pp. $2.50.

Operating Results of Department and Specialty Stores in 1935, by Carl N. Schmalz. Harvard University Bureau of Business Research Bulletin No. 100. 1936. vi, 38 pp. $2.50.

Expenses and Profits of Limited Price Variety Chains in 1934, by Stanley F. Teele. Harvard University Bureau of Business Research Bulletin No. 98. 1935. vi, 46 pp. $1.00.

These annual publications, which have covered a period of six years in one case (variety chains) and eleven years in the other (department stores),

are of interest to statisticians for three reasons: (1) they deal with data covering approximately thirty-five per cent of the department store field and eighty-five per cent of the limited price variety field; (2) the use of well-planned reporting forms permits the assembling and treatment of the data in an authoritative fashion; and (3) they afford an excellent illustration of how the statistician can utilize his data in making constructive suggestions to the owners and managers of business enterprises. Chief interest here centers in the categories set up, the trends set forth, the statistical measures recommended for use in further studies, and the management suggestions made on the basis of the data. The year 1934 brought increased volume to all classes of stores studied, resulting in increased earnings and decreased expense percentages. Prior to 1933, larger stores showed larger earnings percentages than smaller stores. For 1933 and 1934 this profit differential was practically wiped out.

Department stores in 1935 apparently handled a volume of merchandise quite close to the peak volumes of 1929 and 1930. This increase in volume for the larger stores and skillful expense control restored the higher percentage earnings advantage over smaller stores wiped out in 1933 and 1934. It is apparent, therefore, that results in these two years were due to some temporary conditions. The authors suggest that the forces of recovery, considered by some to have benefited agricultural more than industrial areas, may have played some part. There is no doubt that large metropolitan stores, owing to location, financial status, and prestige policies were unable to make reductions in the same ratio as other stores. Volume was the only factor which could cure their expense ills.

All these publications admonish constant study of expense in a period of increasing volume. In many cases, it is known that price changes and "trading down" on the part of the buying public has resulted in large increases in physical volume with smaller increases in dollar volume. When dollar volume increases and expense percentages, particularly payroll percentages, decrease, management is apt to relax its vigilance with resulting disastrous results as regards profits at the end of the year. The data show that it cost the average large department store in 1934 roughly sixty cents to seventy-five cents to serve each customer. The data for 1935 contain approximately the same figures. In the 1935 report, specialty stores showed an average transaction cost of from $1.462 to $1.798 for stores with net sales of one to four million dollars. Although the average sale in such stores is much higher than in large department stores, the comparison of individual items of expense indicates that further savings in expense seem possible. In this connection, the recommendation is made for all types of large stores that surveys should be made to determine what special distributive functions are considered essential by customers and which could be dispensed with or operated on a service charge basis. In comparison, variety chains with a fifty-cent limit, where the average sale is approximately twenty cents, had an average transaction cost of seven cents in 1934. The 1934 study points out that there are possible future repercussions in the wide differen-

tial in costs per transaction between variety stores and department stores.

The authors advocate the wider use of number of transactions per salesperson, costs per transaction, and similar measures in order to narrow down the search for possible legitimate savings. Personal efficiency in both selling and non-selling departments is usually more easily obtained in smaller stores with owner management. Larger stores require statistical data in order to know where work must be done.

Although the differential profit enjoyed by the large department stores has been restored, competitive difficulties in other directions are on the horizon. Other large retail distributing agencies now have buying power and managerial strength equal to the largest department and specialty stores. The 1935 results indicate that management generally has done a satisfactory expense control job, but price level changes are disturbing the highly sensitive and complicated equilibrium between gross margin and the various items of expense. More attention must be given to external as well as internal factors, such as "price trends, general business conditions, political and governmental developments, and public attitude toward business and toward retailers." Increased managerial and public relations skill will be required to consolidate if not to improve the gains made in 1935.

There likewise seems to be an interesting relationship between cash and C.O.D. sales and profits. Those "goal" (most profitable) stores with larger percentages of profit had larger percentages of cash and C.O.D. sales. This result is of interest particularly in view of the many promotions and extensions of installment selling. These same stores, interestingly enough, likewise had higher rates of stock-turn, larger sales per employe, and larger sales per square foot, "all evidence of skillful management." Return goods, that bane of the merchant's existence, "tends to be larger, the larger the store," continuing the long-standing challenge to large-scale retail management to do something about the problem.

The study dealing with limited price variety chains shows conclusively that, despite increased tax burdens and dilution attributable to a marked increase in units inaugurated prior to the depression, this class of retail stores did an outstanding managerial job. On the average, profit was 15.19 per cent of net worth. "Clearly the variety chain trade was in the midst of a rapid expansion when the depression began and was unable to check that expansion until nearly two years of the depression had passed." Tenancy costs as well as taxes, in many cases discriminatory, were management problems that baffled solution. For sixteen identical variety chains, taxes per store (except on real estate and income) increased from $605 in 1929 to $1,360 in 1934.

Variety chains on the whole have been more successful in increasing gross margins than other types of retailers. "Just under thirty-seven cents of the consumer's dollar spent in variety chain stores was needed to cover expenses of the chains and to earn a profit in 1934." Although there were periods of rising prices, favorable to increases in gross margin, there was a general recession of prices continuing into 1935. Despite this price recession there

were increases in gross margins sufficient to cover other increased costs. The authors in this connection call attention to the possibility of future competitive difficulties should this condition be permitted to continue.

JAMES H. GREENE

Retail Merchants Association of Pittsburgh

Insurance or Dole? The Adjustment of Unemployment Insurance to Economic and Social Facts in Great Britain, by E. Wight Bakke. (Published by the Yale University Press for The Institute of Human Relations.) 1935. xiii, 280 pp. $2.50.

Unemployment Insurance (Lessons from British Experience) New York: National Industrial Conference Board, Inc. 1934. viii, 30 pp. 50 cents.

The magnitude and complexity of the problem of administering unemployment insurance, as that form of protection is being developed under the Social Security Act, have made it increasingly evident that foreign experience must be fully utilized. The British experience is especially profitable for such exploitation, since it covers twenty-three years (the longest span of any such scheme), is rich in adjustment to changing economic and social conditions, and provides extensive records covering the various stages of its development.

Mr. Bakke's purpose in the present volume is to consider "fundamental problems of principle and policy connected with unemployment insurance which require all the light that experience can furnish." He seeks this objective through a critical and realistic scrutiny of outstanding administrative problems in Great Britain and by examining the more important modifications in the basic provisions of the British unemployment insurance legislation in relation to the economic and social realities which generated them. The analysis of administrative problems and statutory provisions is significant in itself, and many references to specific terms in the legislation and the resulting administrative procedures should be valuable for American readers. In addition, the volume is illuminating as a case history of social change; it traces the evolution of a new national attitude toward the protection of the unemployed. We are shown the steadily broadening front of the attack on unemployment in Great Britain, a development that is now also under way in this country.

When the unemployment insurance system of Great Britain was created in 1911, it gave limited recognition to the theory that unemployment could no longer be regarded as the fault of the individual. Since then the principle of national responsibility for the unemployed has become more deeply rooted with the result that the Unemployment Act of 1934 represents the government's acceptance of an obligation not merely to the *insured* but to all the *genuinely unemployed*. The early planners of the system could not fully foresee the nature and extent of the problem with which they were dealing. When, toward the end of the decade, the character of post-War unemploy-

ment was better understood, the original concept of unemployment benefit as a temporary stop-gap had to be abandoned. It had become clear that thousands of the jobless would never regain their former industrial status and that certain industrial areas were harnessed to labor surpluses which they would be powerless to move. The pressure of local authorities, which reacted to their problem in much the same way as the United States Conference of Mayors has here, was added to that of a strongly organized labor movement for assumption of greater responsibility by the national government. The need of providing jobs *or* maintenance was finally accepted as a proper debt of the country to its industrial army, even those members of it who were not qualified for benefit by the terms of the insurance legislation. Accordingly, in the 1934 law public assistance as a right, though determined by need and financed almost entirely by the national government, was made a supplement to the contributory insurance system.

But money payments, no matter how efficiently and generously administered, are far from being a complete solution. Measures are needed "to relate individual workers to society again as workers," and Mr. Bakke believes that "if the size of the problem increases very far beyond its present proportions society will realize what a disservice is done to social stability when a destitute leisure group is supported within a working population." Mr. Bakke indicates steps Great Britain has taken "beyond insurance" and suggests further alternatives. Certainly intelligent planning of an unemployment insurance system can no longer overlook the larger questions of emergency employment, re-training and relief.

The volume throws light on basic problems confronting American social security legislation. It points to the vital need of full understanding of the nature of our unemployment problem in order that our provision may be based on reality. The registration of the insured working population as a condition for unemployment insurance benefit has yielded Great Britain comprehensive, accurate, and nearly complete unemployment data on its working population. Only by corresponding organization and use of the public employment office system can adequate information be obtained in the United States. Unfortunately, in view of the Federal-state set-up of employment offices and unemployment insurance in this country and the consequent differences in administrative and statistical procedure, it will be years before we obtain an approximation of the British unemployment data. It must also be realized that a successful unemployment insurance scheme must be no less flexible than the British system has been; moreover it must be planned in close relationship with measures beyond insurance, for amid the uncertainty of modern industry a self-respecting citizen cannot fairly be treated like a pauper merely because he fails for statutory reasons to qualify for insurance benefits.

Incidentally, for those who insist on measuring the success of the British unemployment insurance system by financial criteria alone, it should be noted that at the end of 1935, after meeting all claims and paying the required installments on the debt to the Treasury, the fund had a surplus of

£21,449,810. For this reason benefits for dependents have been increased, and contributions for all three parties have been reduced.

The usefulness of the present volume is enhanced by appendices, which include a short history of the British unemployment insurance system, a brief summary of the present law and public assistance scheme, and some statistical material.

The purpose of the Conference Board's thirty-page pamphlet is to set forth the lessons from British experience with unemployment insurance. It summarizes the Acts of 1911 and 1920 and later extensions of the scheme, the report of the Royal Commission on Unemployment Insurance presented in November, 1932, and the Unemployment Act of 1934. The pamphlet is a convenient condensation of some of the principal pronouncements of the more important official documents on the subject.

In view of many assertions in this country that British employers are opposed to unemployment insurance, it may be noted that the National Confederation of Employers' Organizations in its recommendations to the Royal Commission said: "A compulsory system of contributory unemployment insurance should form a part of the industrial organization of the country."

In the page and a half entitled "Lessons from British Experience," most space is given to a suggestion that before any compulsory scheme of unemployment relief is adopted in the United States a fact-finding body should be established under Government auspices to make a thorough survey of the problem and to make recommendations for action by industry and by the legislatures. Great Britain had its Royal Commission on the Poor Laws and Relief of Distress, and no doubt the United States would have planned its legislation more effectively if some such body had executed a correspondingly comprehensive, thorough, and scientific investigation here. Concerning the statistics of unemployment, however, little is to be gained by any sudden sally into that field; unemployment insurance like many other new insurance forms will have to build up its factual basis as it operates.

BRYCE M. STEWART

Industrial Relations Counselors, Inc.
New York City

Law and Labor Relations, A Study of the Industrial Disputes Investigation Act of Canada, by B. M. Selekman. Business Research Studies No. 14, Volume XXIII, Number 1, Harvard University Graduate School of Business Administration, Bureau of Business Research, Boston. March, 1936. v, 65 pp. $1.00.

The publication of this monograph, which presents the results of Mr. Selekman's latest research into and analysis and appraisal of the operation of the Canadian Industrial Disputes Investigation Act, is most timely; it deserves wide reading and careful study by all who have been concerned with the uncertainty of trends and the accelerated pace of changes in labor relations in the United States during recent years.

The timeliness and value of the work lies not so much in its bringing up to date the history of the Act and the developments in its operation and administration (covered in Chapter II); or in its well documented, fairly detailed presentation of cases and Board decisions on wages and hours (Chapter III) and on employees' representation and collective bargaining (Chapter IV). Rather is Mr. Selekman's study noteworthy because of its objective analysis of employers' and workers' changing attitudes toward the Act, with the reasons therefore (Chapter V); and because of its mature appraisal of significance of the Canadian experience for the United States (Chapter VI).

Mr. Selekman finds (1) that following the decision of the British Privy Council in 1925 declaring the Disputes Act *ultra vires* or "unconstitutional," the Act was reestablished, with the strong support of unions and without much opposition from employers, practically throughout Canada by both dominion and provincial laws; (2) that the Act has continued to enjoy the confidence and endorsement of unions (both minority and majority), of employers, and of the public; (3) that, following the first unfavorable reactions during the War period, the unions have come to support the Act, in spite of its infringement of their right to strike, because the administrators have, in the absence of any specific industrial code, gradually developed a labor common law or set of customs which have shown definite trends toward higher wages, fewer hours, better working conditions, and (in recent years) improved democratic status of labor in industry; (4) that employers, although less warm towards the Act because of its restrictions on freedom of management and favoring its operation mainly in public utilities, have not voiced strong opposition because the administrators have succeeded in reducing interruptions to production and have made for more orderly labor relations; (5) that the success of the Act and its administration has lain in the subordination of the Act's formal compulsions to the mediation process and to the force of public opinion.

In the light of the Canadian experience, Mr. Selekman is less than enthusiastic about the Wagner Labor Disputes Act in this country, with its semijudicial methods of promoting collective bargaining and labor democracy. He points out (1) that prior to the passage of the Wagner Act, unions had gradually succeeded in securing legislation (such as the Norris-LaGuardia Act) which removed some of the old common law disabilities and, in effect, made it easier for labor to help itself; (2) that nevertheless unions were still outlaws in American custom, i.e., in the minds of employers; (3) that the Wagner Act, instead of freeing labor and helping it to help itself, makes unions wards of the state and tries, in effect, to force employers to change their minds about unions; (4) that in the end employers' resistance may be heightened and industrial conflict may be fostered to such an extent that there may be successful moves for infringement on the right of labor to strike and help itself.

The attitude of most employers in this country may be deplored as shortsighted and antisocial. The attitude nevertheless is a fact to be reckoned with. Therefore, concludes Mr. Selekman, "the immediate task for govern-

ment would seem to be to free both sides so that they may develop as equals, rather than to introduce the principle of compulsory regulation in so delicate and fluid an area as industrial relationships in the United States today. That principle once established may be extended with dangerous possibilities to all concerned—trade unions and consumers, as well as employers."

CARROLL R. DAUGHERTY

University of Pittsburgh

Executive Guidance of Industrial Relations, An Analysis of the Experience of Twenty-Five Companies, by C. Canby Balderston. Philadelphia: University of Pennsylvania Press. 1935. x, 435 pp. $3.75.

Industrial relations policies have too frequently been lifted out of their setting and examined separately with regard to their adequacy in providing what the particular investigator or student believes to be a proper social or economic program of an employer for his employees. Professor Balderston places personnel policy where it belongs, as a part of a coordinated company policy which is controlled by many factors that are overlooked or disregarded by the casual and superficial investigator. The author sums up this dependence of industrial relations policy on the very practical considerations of business operation in these words: "No matter how well intended may be the efforts of a manager to put into effect an enlightened personnel program, he must bow to his master, economic forces. However high be his ideals, he cannot ignore profit stability, labor, overhead, and raw material costs, seasonal and cyclical variations in production, the traditions behind his industry, the financial strength of his company, and the myriad of other factors which cannot be measured." This understanding statement of a truth often ignored is commended to those who glibly criticize the social attitude and shortcomings of business management and impugn its motives, with little understanding of the problems involved.

As a preliminary to his analysis, the author has studied intensively the industrial relations programs of twenty-five prominent American business concerns, most of which are closely identified with the development of modern personnel technique and a broader conception of management responsibility in the improvement of working conditions. He presents condensed summaries of the personnel policies of these companies, and these summaries in themselves constitute a valuable factual contribution to industrial relations literature. More original, however, is his analysis of the economic and personality factors which play so large a part in the determination of a company's personnel policy and the translation of this policy into actual everyday relationships.

What appears to be the author's main purpose—the construction of a standard of current good practice by which company executives may appraise their own personnel programs—is developed first by enumerating what he considers the essentials of a personnel program, and then by discussing the significance, purpose, and, in some cases, an illustrative exemplification of each item. These essentials as set forth by the author are: (1) The

prerequisites—fair wages and fair dealing; (2) the guidance of a definite policy; (3) the support of the chief executive and the proper place of personnel in the organization; (4) the regularization of employment; (5) unemployment reserves; (6) insurance against death, illness, and accidents; (7) pensions and annuities; (8) standardization of base rates and salaries; (9) financial and non-financial incentives; (10) systematic promotion policy and the auditing of its results; (11) selection, placement, and training; (12) reduction of accidents and illness; (13) joint relations—employee representation, union agreements.

In a number of cases these essentials are attitudes or policies rather than specific activities. This is as it should be, since the basic philosophy which underlies an industrial relations policy is far more significant than any catalogue of activities. Although the list of essentials may, in the aggregate, seem to constitute a rather ambitious standard to apply to the rank and file of business concerns, the author probably has in mind relatively large organizations, and, moreover, most of the items or policies are susceptible of adaptation to the size, resources, and scale of operation of any particular establishment. Again the emphasis is on the principle involved and not on any particular mechanism or technique. One is inclined to wish that Professor Balderston's objective analysis of the fundamentals of a well-considered and adequate personnel policy could be made available in a condensed, briefer publication to encourage its study by executives who instinctively shy away from what, to them, has the appearance of a formidable volume.

H. F. BROWNE

National Industrial Conference Board

Labor Fact Book No. III, Labor Research Association. New York: International Publishers. 1936. 223 pages. $2.00.

The Labor Fact Book series of the Labor Research Association possesses two virtues not commonly found in "books of facts": Within a compass of a little more than 200 pages, these books present in an organized fashion a compendium of current politico-economic facts for which one would otherwise need to make search in many widely scattered sources; the "facts" are not mere statistical tabulations but running commentaries for the instruction and the enlightenment of those who wish to see these facts in the light of the interests of labor. The Labor Fact Books, according to the authors, are "prepared for the use of workers, farmers, students of economics and sociology, writers, speakers, organizers and all others engaged in any form of activity in the labor movement in its broadest sense." In our preoccupation with the search and collection of original data in social economics and particularly in our technical treatment of such data, we often forget and overlook the very significant fact that behind these data lie human values. Our failure to note these human implications becomes especially deplorable in times of social stress. The Labor Fact Books emphasize precisely these underlying values. They translate the facts and figures into their meaning to

man,—to labor, and show how they impinge on man's efforts to improve his lot today and tomorrow.

Labor Fact Book No. III deviates from its predecessors[1] in its more extended treatment of "Farmers and Farm Workers" (Chapter VII) and in the introduction into the purview of "labor," of facts pertaining to the place of the "Professional Workers" (Chapter VI) in the industrial economy of the day. In the chapter on "Farmers and Farm Workers," the Labor Research Association reminds us that between 1933 and 1935 "over 800,000 American farmers lost their farms through foreclosures" and that in the spring of 1935 "over 700,000 farmers and their families, together with 600,000 agricultural workers, were on Federal relief rolls"; that nearly one-third of the increase in the farmer's cash income between 1933 and 1934 "came from the larger sales of cattle and sheep which had to be sacrificed because of the drought." Under the caption "Who Buys the Farms," it is pointed out that at the beginning of 1935 insurance companies held 16 per cent of the farm mortgages in comparison with 23 per cent at the beginning of 1928, and the commercial banks held 6 per cent in comparison with 11 per cent on the corresponding dates. On the other hand, the Federal Land Banks and the Land Bank Commissioner held one-third of the farm mortgage debt in the spring of 1935 in comparison with 12 per cent in the beginning of 1928. "These facts clearly reflect the Government's course in bailing out the mortgage holders," the authors comment. The section on "Agricultural Workers" is particularly enlightening, especially where it deals with the strikes of farm workers and the organizational strength of share-croppers and tenant unions.

The chapter on "Professional Workers" is unique in that for the first time facts are brought together pertaining to the organizational strength of professional workers as trade unionists. Some 250,000 professional workers, we are told, are now organized in trade unions and other organizations with acknowledged protective purposes. Eight pages of small type give brief sketches of the organizational history and strength of a number of professions, including musicians, teachers, journalists, and librarians. Informative is the sketch of the organization and purpose of the Inter-Professional Association and the role it is assuming in giving unified direction to the growing efforts of the workers in the professions in making common cause with labor in industry to the end of securing social legislation for the protection and betterment of the wage as well as the salaried workers, laying special emphasis on the enactment of an all-inclusive program of social insurance.

A listing of the activities of almost two score of fascist and near-fascist organizations operating in this country and a table on "Killings of Workers" (pages 172–178) and another on notable strikes of 1934–1935 (pages 72–78) point to the emphasis placed by the authors on the need for a growing awareness of labor of the struggles it faces to maintain its own freedom of action as well as the fight which it must carry on for the protection of the democratic rights of the American people in general.

JOSEPH M. GILLMAN

Washington, D. C.

[1] A review of *Labor Fact Book* No. II appeared in this JOURNAL for March, 1935.

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